THE UNIVERSITY OF ALBERTA

CHILDREN'S CATEGORIZATIONS OF WORD DEFINITIONS

BY

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A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR

THE DEGREE OF MASTER OF EDUCATION

DEPARTMENT OF EDUCATIONAL PSYCHOLOGY

EDMONTON, ALBERTA

FALL, 1972

UNIVERSITY OF ALBERTA

FACULTY OF GRADUATE STUDIES AND RESEARCH

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research for acceptance, a thesis entitled "Children's Categorizations of Word Definitions" submitted by Ronald B. Patsula in partial fulfillment of the requirements for the degree of Master of Education.

ABSTRACT

Evanechko (1970) postulated twenty-four categories of logico-semantic relations which would account for types of definitions used by children to define words. To establish empirically (1) that these categories are recognized by children and (2) that children are able to discriminate among kinds of definitions were the major purposes of the present study.

The present study used Wiley's (1967) Latent Partition Analysis (LPA) to determine the categories of word definitions which children at different grade levels recognize. A population of 570 subjects from the fifth (176), eighth (196) and eleventh (198) grade were first requested to group different examples of word definitions into separate categories, so that each category contained definitions which were similiar. Definitions were to be considered similiar if they gave meaning to different words in the same manner.

The latent partitions determined for the subjects of each of the three grade levels of interest were found to be in close agreement to the theoretical partitioning of the examples of word definitions as postulated by Evanechko. The ability to recognize types of definitions and to be able to discriminate among kinds of logico-semantic relations reflected a probable developmental trend. The latent partitions by the subjects from the higher grades were found to be in closer agreement to the theoretical partitioning of the examples of word definitions than the latent partitions by the subjects from the lower grades

Subjects were then asked to write explanations of the rules which they used to categorize the word definitions. These explanations were used to determine the different grouping strategies prevalent among the subjects of the three different grade levels. A categorization of grouping strategies advocated by Vygotsky (1962) and Bruner (1963, 1964) was used to illustrate that the strategies applied to the sorting task by the subjects followed a developmental trend.

Subjects in the lower grades tended to orient on the subject matter of the word being defined and to use grouping strategies which were categorized as complexes (a grouping strategy in which no single rule logically explained the inclusion of all the examples of word definitions which they placed in a single grouping). Subjects in the higher grades tended to use definition oriented concepts which universally included all the word definitions which they grouped together.

It was judged that the use of the Latent Partition Analysis model could be more widely applied to studies concerned with conceptual structures latent to particular populations of individuals. It was also suggested that a series of individual case studies in which the subjects are encouraged to verbalize their thinking while categorizing a set of stimuli would help to enrich the quantitative results obtained from LPA. The verbalizations could help the investigator to determine the "how" and "why" of concept formation and LPA could help to establish the "what" of conceptual inclusion.

ACKNOWLEDGEMENTS

The writer wishes to express his sincere appreciation to Dr. T. O. Maguire for his guidance and assistence in the formulation and completion of this thesis. Thanks are also expressed to the other committee members: Drs. A. R. Hakstian, and D. Sawada.

Appreciation is also extended to the Edmonton Separate School Board and the pupils, teachers, and principals who co-operated in this study.

Thanks are also given to my sister, Mrs. L. Jamieson, for the typing of the final draft of this thesis; the mathematical symbols and many numerical tables made this a very grueling contribution.

It is with great joy that this thesis is dedicated to my wife and children. Their presence and love helped to give proper order to an over-scheduled timetable and their confidence and encouragement helped to furnish the will to persevere.

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CHAPTER I

INTRODUCTION

When a child is asked the meaning of a particular word, his response, depending on his semantic competence, will be at varying levels of sophistication. It is expected that the responses of younger children would be more egocentric and bounded by their limited personal experiences. The older child's responses would more nearly approximate those of an adult (Evanechko, 1970).

Evanechko (1970), outlined twenth-four discrete kinds of logico-semantic relations exhibited in definitions used by children (Table 1). These categories were gleaned from an extensive survey of the literature dealing with children's word usage. The purposes of his study were to investigate the nature of semantic processes and the concept of semantic space. Evanechko postulated that meaning was given to a symbol (word) by its unique coordinates within the child's semantic space. The meaning space results from the individual's learning history and is dimensioned by assigning different weightings to varying combinations of the twenty-four logico-semantic relations.

Evanechko (1970) developed the Semantic Feature Test (SF test) which required the child to choose the "better" definition from a pair. The test consisted of 276 paired comparison items, each definition illustrative of one of the logico-semantic relations. The SF test was administered to 266 students in the fifth and eighth grades. Using multidimensional scaling techniques the data were analyzed and the resulting theoretical semantic spaces of each grade compared.

TABLE 1

TWENTY-FOUR CATEGORIES OF LOGICO-SEMANTIC RELATIONS
EXHIBITED IN DEFINITIONS USED BY CHILDREN

1. Synonym. The members of each word pair have exactly or very nearly the same referent:
   e.g. steal - rob
   big - large

2. Similarity. The members of each word pair are similar through being aligned on some dimension, with the referent of the right-hand member occupying a more extreme position of this dimension:
   e.g. hungry - starving
   small - tiny

3. Superordinate. The left-hand member denotes a common class of which the right-hand concept is a member:
   e.g. fruit - apple
   bird - sparrow

4. Coordinate. The members of each pair refer to familiar members of a familiar class:
   e.g. chair - table
   beets - peas

5. Attribute. The right-hand member of each pair refers to a quality or attribute generally recognized as characterizing the object denoted by the left-hand member:
   e.g. turtle - slow
   lemon - sour

6. Contrast. The members of each word pair refer to opposite ends of a continuum:
   e.g. hard - easy
   loud - soft

7. Action-of. The right-hand member of each pair is an intransitive verb denoting concrete action associated with and performed by the agent referred to by the left-hand member:
   e.g. baby - cry
   dog - bark

8. Action-upon. The left-hand member of each pair is a transitive verb denoting a concrete action associated with and performed upon the object referred to by the right-hand member:
   e.g. sweep - floor
   throw - ball

9. Whole-part. The right-hand member of each pair refers to a familiar object recognized as an important part of a familiar whole denoted by the left-hand member:

    e.g. bird - wing
    hand - finger

10. Part-part. The members of each pair refer to familiar objects which are parts of a familiar whole:

    e.g. wall - floor
    arm - head

11. Common use. The right-hand member of each pair denotes an object associated with and acted upon by the agent referred to by the left-hand member:

    e.g. farmer - tractor
    dog - bone

12. Use of. The right-hand member of each unit denotes a use made of the left-hand member:

    e.g. envelope - for putting letters in
    orange - for eating

13. Repetition. The right-hand member of each unit is a repetition of the concept referred to by the left-hand member:

    e.g. drink - a drink of water
    tap - a tap on the wall

14. Contiguity. The left-hand member of the unit is defined by direct concrete interaction of place, time or activity with the right-hand member:

    e.g. apple - grows on a tree
    late - you can see by the clock

15. Free association. The members of the unit are free associates:

    e.g. carry - heavy
    enjoy - fun

16. Connotation. The right-hand member of each pair connotes a relationship with the left-hand member:

    e.g. modern - good
    royal - strong

17. Analysis. The right-hand member is an analysis of the left-hand member indicating certain dimensions of function of this concept:

    e.g. lengthen - make a thing longer
    rule - to control people

18. Synthesis. The right-hand member defines the left-hand member by stating its relation with other concepts commonly associated with it:
    e.g. acorns - from an oak tree
    bunk - it has two levels

19. Extension of a class (Implication). The right-hand member of the unit gives examples of concepts to which the left-hand member might refer implying a degree of familiarity with the concept:
    e.g. farming - crops and animals
    bugs - insects and flies

20. Denotation in Context. The left-hand member is defined by use in context:
    e.g. sharpen - sharpen the knife till it cuts well
    bitten - bitten by a snake

21. Ostensive Definition. The right-hand member defines the left-hand member largely on the basis of experience:
    e.g. selfish - all for yourself
    tickle - you make someone laugh

22. Generic Definitions. The right-hand member denotes the common class to which the left-hand member belongs:
    e.g. kindle - burn
    cup - dinnerware

23. Class membership implied. The right-hand phrase attempts to bridge the gap between general and specific by using phrases such as "a kind of", "sort of" or "like a":
    e.g. stool - like a chair
    cone - like an ice-cream cone

24. Intension of a class (Genus et Differentia). The right-hand member states the class as well as the distinguishing features of the left-hand member:
    e.g. sipped - drank a little at a time
    notice - see and remember

THE PROBLEM AND PURPOSE OF STUDY

The 24 categories of logico-semantic relations used in Evanechko's study were obtained from a survey of the literature. To a large extent these categories owed their existence to adult logic and may exist only in the minds of adults as useful abstractions for classifying. A child's definition of a word may be classified by an observer as illustrating a given category of the logico-semantic relations but the child may or may not be using such a classification system. In Gagne's (1965, 1968) cumulative learning model the capability of using a simple rule is dependent upon the mastery of certain lower level tasks such as the recallability of previously learned discriminations, chains and stimulus-response connections. The definition of an individual word can be accomplished at the level of simple stimulus-response connections and the higher capability of being able to apply the rules of a classification system may or may not yet be learned.

The main purpose of this study is to ascertain if children of different grade levels recognize the uniqueness of each one of Evanechko's categories. Does the child recognize one method of giving meaning to a word as distinct from another method? A corollary to this question is that the ability to accrue meaning of words is developmental. This corollary will be investigated.

The Word Definition Survey (WDS) was developed by Dr. T. Maguire and the present writer for the purpose of this study. It was administered to 176 grade five students, 196 grade eight students and

198 grade eleven students. The subjects were given examples of definitions, each typed on a separate card, and were asked to sort them into homogeneous categories. The examples were taken from a list supplied by Evanechko (Appendix A). Latent partition analysis (LPA) (Wiley, 1967) was the technique used to recover the categories of word meaning. To determine the efficacy of LPA to problems of this nature was a secondary purpose of this study. The grouping strategies of children at different age levels were also noted.

The latent partition analysis (LPA) model developed by Wiley (1967) analyzes data collected from subjects who were instructed to categorize a set of concepts into homogeneous sets. The categorization of the items by a subject into distinct sets is called his manifest partition (Z_i). The LPA model produces a hypothetical latent partition (Φ) of the items common to the processes of all sorters. The Φ for all sorters is assumed constant and the entries of Φ indicate the category of the latent partitioning to which a particular item belongs. The LPA model also produces a confusion matrix (Ω), a probability matrix of joint occurrence, which indicates the average degree of confusing items from different categories.

The WDS requested the subjects to place items into sets so that each set contains similiar definitions. Subjects were told that definitions were to be considered similiar if they gave meaning to words in the same way. For analysis purposes definitions were considered to be similiar if they belonged to the same categorie of the twenty-four logico-semantic relations. The theoretical partition (Φ_T) of a group of

definitions was defined as the partitioning of the definitions according to Evanechko's categories.

HYPOTHESES

The following general hypothesis was formulated: The latent partition of word definitions obtained for each grade level will correspond to the theoretical partition.

The WDS was designed to determine how subjects grouped different examples from Evanechko's definitions into sets of similiar definitions. The outputs from the LPA of the data were the latent partition and the confusion matrix for grade eleven (Φ_{11} and Ω_{11}), the latent partition and the confusion matrix for grade eight (Φ_8 and Ω_8) and the latent partion and the confusion matrix for grade five (Φ_5 and Ω_5). A set of research hypotheses concerning the categorization and grouping strategies of the subjects of the different grades follows:

1. The latent partition of definitions for each grade will relate to Φ_T.

    (i) Φ_{11} will closely reflect Φ_T.

    (ii) Φ_8 will closely reflect Φ_T.

    (iii) Φ_5 will closely reflect Φ_T.

2. The ability to attribute meaning to words is developmental.

    (i) Φ_{11} will more closely correspond to Φ_T than will Φ_8.

    (ii) Φ_8 will more closely correspond to Φ_T than will Φ_5.

    (iii) Φ_8 will more closely correspond to Φ_{11} than will Φ_5.

3. Subjects in higher grades will show more inter-subject consistency in their grouping of the definitions than will subjects in lower grades.

(i) Ω_{11} will show lower variation than Ω_8.

(ii) Ω_8 will show lower variation than Ω_5.

4. Grouping strategies used by subjects at different grade levels will illustrate a developmental trend.

CHAPTER II

RELATED LITERATURE

THE DIMENSIONS OF CHILDREN'S MEANING SPACE

In Evanechko's study (1970), the individual's semantic competence was considered to result from and be defined by his semantic space; a concept denoting the means by which verbal stimuli are processed. Semantic space is a hypothetical construct which was defined as a n-dimensional, Euclidian space; the dimensions of this space being comprised of categories of logico-semantic relations. It was postulated that meaning is attached to a word by locating the verbal symbol in the individual's semantic space and, therefore, depends upon the dimensions which constitute this space. These dimensions define the limits of the individual's semantic capacity and constitute orienting responses to words which result from his particular learning history.

The dimensions of a person's semantic space as defined by Evanechko were composed of logico-semantic relations. The extent to which fifth, eighth and eleventh grade students actually use and recognize the twenty-four different categories was the major purpose of this study.

Evanechko's model of a semantic space implies a developmental process. A child or an uneducated adult would be expected to know a word less fully than an educated adult. Particular words, when placed in an individual's semantic space, would draw upon certain specific dimensions for meaning. The novice learner would have fewer dimensions available to impart meaning to the word and the dimensions available would most likely be comprised of categories of logico-semantic relations dealing

with use of free association, class membership implied, repetition and illustration (both superordinate and generic) types of word definitions Feifel and Lorge (1950) established the use of similar classes of qualitative responses by young children on a vocabulary test. Some of Evanechko's (1970) results tend to verify the above observation:

> ...The Grade V group generally displayed less abstract and economical strategies of ascribing meaning to words than the older Ss. They examined the similarity among concepts in their own experience along with the action and function of these concepts. Concrete personal experiences and the context of concepts were important in identifying concepts with the connotative aspect of meaning also playing an important function. ...Finally, this group considered the characteristics of referents important in identifying concepts (p. 245).

Figure 1 is a model of a semantic space as proposed by the present writer.

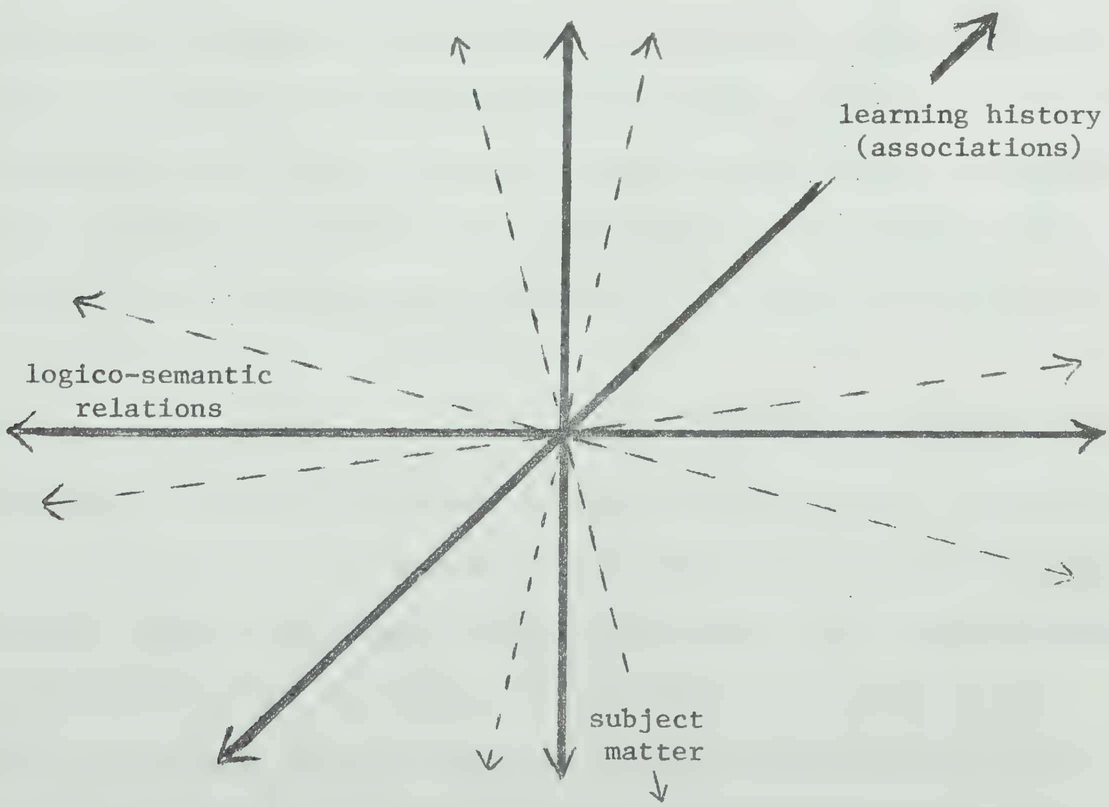

Fig. 1 MODEL OF A COMPLEX SEMANTIC SPACE

The semantic space of some individuals may be very simple while others more complex. Not all dimensions would be used to give meaning to each word. In the case of a very young learner only simple associations would be used. The meaning of a word would not be a result of projections on several dimensions but more likely a one-to-one correspondence between word and significate. For this reason, in the model, the dimensions dealing with simple learned associations have been emphasized. An example of this would be the relationship between the word ball and its significate round.

It is thought that even in the case of adults the first reaction would result in projections on dimensions dealing with the subject matter of the word. These dimensions would include the categories of superordinate and generic definitions. Is this word animal, vegetable or mineral? Is this word a noun, verb, adjective, adverb or conjunction? In some cases this first reaction or linear projection onto a dimension of the individual's semantic space will suffice and, therefore, these dimensions are given emphasis in the model. An example of this would be: robin - bird.

For most adults the meaning of a word would result from the projections on several dimensions of their semantic-space. The above position suggests an active role for the organism in processing verbal stimuli. Meaning considered from this perspective is a dynamic process. The first orientation concerning subject matter may be followed by other orientations towards dimensions dealing with attribute, use of, analysis, synthesis, etc.

One of the tasks performed by the subjects of this study was to group different word definitions into sets containing definitions of the same type. It was anticipated that in deciding which definitions were similar the older subjects would tend to orientate on dimensions of their semantic space which would reflect the twenty-four categories of Evanechko's (1970) logico-semantic relations. It was thought that younger learners might tend to "personalize" the situation by orientating on the subject matter of the words being defined. An individual may decide that two definitions are similar because they are defining words which are dealing with the same subject matter. The significates of the word definition might not even be considered.

LATENT PARTITION ANALYSIS

Latent Partition Analysis (LPA) was developed by Wiley (1967). He noticed apparent similarities between groupings resulting when a number of judges were asked to sort a set of items into what they considered homogeneous categories. The LPA model is based on the assumption that when a relatively homogeneous group of individuals is asked to sort a group of items into categories there exists a hypothetical latent partition (Φ) which underlies each individual's manifest partition (Z_i).

Wiley based his model on a fixed population of sorters. No inferences were to be made to a theoretical potential population of sorters. The Φ matrix was taken to reflect the underlying latent

categorization of the items for only the actual group of sorters. Evans (1970) developed a model based on observations obtained from judges randomly selected from a defined population of judges. The object of his analysis was "to provide a useful description of the way the stimuli tend to be classified by persons in a given population" (Evans, 1970, p. 368). In the present study subjects were not chosen as a random sample from a population of interest but were taken from intact schools at specified grade levels. Therefore this study is to be descriptive rather than inferential in nature and it was decided that Wiley's (1967) model would be appropriate.

The $\phi_{j\mu}$ element of matrix Φ is 1 or 0 according as item j is in latent category μ or not. Wiley argued that Z_i could be derived from Φ by the formula:

$$E(Z_i) = \Pi_i \Phi$$

where the (m, μ)th entry of Π_i is the probability with which any item from latent category μ is included in subject's i manifest category m.

If there are N fixed judges, K items or stimuli to be categorized, and L categories in Φ, then, for each judge i there are defined matrices Σ_i and Δ_i^2 each of order K x K, and Ω_i of order L x L. Σ_i is the expectation of S_i, $\Sigma_i = E(S_i)$, where S_i is a matrix of item joint occurrence and is derived from Z_i by the formula:

$$S_i = Z_i' Z_i$$

The (j, k)th entry of Σ_i is the probability that judge i puts item j in the same manifest category as item k. The (μ, ν)th entry of Ω_i is (even when $\mu = \nu$) the probability of joint occurrence of any

pair of distinct items from latent categories μ and ν. Δ_i^2 is a diagonal matrix and the jth diagonal entry (δ_{jj}) of Δ_i^2 measures the diversity of item j for judge i. The quantity $(1 - \delta_{jj}^2)$ is the probability that judge i puts item j and any other item from the same latent category as item j into the same manifest category. The matrix Σ, Δ^2 and Ω are the averages of the matrix Σ_i, Δ_i^2 and Ω_i respectively for the N fixed judges.

From the above definitions and assumptions it follows that

$$\Sigma = \Phi'\Omega\Phi + \Delta^2,$$

which is the fundamental equation in the treatment of the model (Wiley, 1967; Evans, 1970).

In practice the S matrix is used as an estimate of Σ, and Δ^2 is obtained through an iterative process (Wiley, 1967, p. 188). Therefore given the matrix S (the joint proportion matrix, $S = N^{-1} \Sigma S_i$), LPA yields (1) a hypothetical latent grouping of the stimuli, the Φ matrix, for the population; and (2) the Ω matrix indicating the probability of any pair of items from two different latent categories occurring in the same manifest category.

GROUPING STRATEGIES

The study of grouping strategies used by children is closely tied to the study of concept formation. Grouping strategies include the application of concepts. Concept formation is defined as the forming of abstract ideas generalized from particular instances. The degree of involvement of concepts and, or the sophistication of the concepts within a grouping strategy is often used as a means of

classifying the grouping strategy.

Vygotsky (1962) performed a series of investigations using the method of "double stimulation" and his principal findings may be summarized as follows: The process of concept formation is developmental. This process begins in early childhood but reaches its full development only in adolescence. Lacking the intellectual functions of true concepts the child used equivalent functional forms which perform similar operations. The developmental mechanism itself that results in concept formation is the use of words. "Learning to direct one's own mental processes with the aid of words or signs is an integral part of the process of concept formation" (Vygotsky, 1962, p. 59). The use of words as a means of concept formation is considered as the immediate psychological cause of the radical change in the intellectual process that occurs around the age of twelve.

Vygotsky outlines three basic phases that are passed through in the ascent to concept formation:

1. The first step taken by a child towards concept formation is when he puts together a number of objects in an unorganized congeries, or "heap", in order to solve a problem that adults would normally solve by forming a new concept. "The heap, consisting of disparate objects grouped together without any basis reveals a diffuse, undirected extension of the meaning of the sign (artificial word) to inherently unrelated objects linked by chance in the child's perception" (Vygotsky, 1962, p. 59). A heap is formed by the trial-and-error or random inclusion of objects; or the objects are included because they

happen to be included in the visual field of the child's immediate perception.

2. An ascent to a higher level is reached when the child starts thinking in "complexes". Objects are united in the child's mind not only by his subjective impressions but also by bonds actually existing between these objects. A complex is a concrete grouping of objects connected by factual bonds but these bonds lack logical unity. The factual reasons for including the objects in the group may be as varied as the actual number of objects. No single rule logically explains the inclusion of all objects.

3. The third and final step is taken when true concepts begin to be formed. Vygotsky (1962) points out that:

> Even after the adolescent has learned to produce concepts, however, he does not abandon the more elementary forms; they continue for a long time to operate, indeed to predominate, in many areas of his thinking. Adolescence is less a period of completion than one of crisis and transition. ...The adolescent will form and use a concept quite correctly in a concrete situation but will find it strangely difficult to express that concept in words, and the verbal definition will, in most cases, be much narrower than might have been expected from the way he used the concept. The same discrepancy occurs also in adult thinking, even at very advanced levels (p. 79).

Vygotsky's three stages may be characterized by the child's use of subjective reasoning, subjective and factual reasoning, and finally subjective, factual and logical reasoning.

Bruner (1963, 1964) also studied the different types of grouping strategies used by different ages. He distinguished two aspects of grouping. The first had to do with the features or attributes that children use as a criterion for grouping objects:

perceptual features, arbitrary functional features and appropriate functional features. The second aspect was characterized in terms of the syntactical structure of the equivalence sets that the child develops. These are Vygotsky's heaps, complexes and true concepts. Bruner calls true concepts "superordinate concepts", and defines them as having one universal rule of inclusion accounting for all objects in the set.

Bruner (1964) mentions that the pattern of growth or trends in the grouping strategies of children is developmental:

> ...the youngest children rely more heavily on perceptual attributes than do the others. As they grow older, grouping comes to depend increasingly upon the functional properties of things ...The shift from perceptual to functional groupings is accompanied by a corresponding shift in the syntactical structure of the groups formed. Complexive groupings steadily dwindle; superordinate groupings rise, until the latter almost replace the former in late adolescence (p. 10-11).

Five complex-forming maneuvers were reported in the literature reviewed (Vygotsky, 1962; Bruner, 1963):

1. Associative type: The child notes a factual relationship between two objects. All other objects of the group are related to this factual relationship.

2. Key ring: One object is taken as the key and all the other objects in the group are included because they possess an attribute in common with the key object.

3. Edge matching: Associative links are formed between neighbouring items in the group. Therefore n - 1 reasons or rules for inclusion are mentioned.

4. Collections: Objects are included on the basis of some one trait in which they differ and consequently complement one another.

5. Thematic grouping: A story is told which includes all of the objects in the group.

A similar classification system was used to help indicate a developmental trend in the grouping strategies of the subjects in this study. After sorting the word definitions into sets containing similar definitions the subjects were asked to explain the grouping strategy which they employed in deciding to place certain word definitions together. These explanations were then classified as typifying either thematic grouping, complexes or superordinate concepts. Thematic grouping was taken to illustrate the lowest form of the complex-forming maneuvers for the subjects of this study.

The viewpoint of Gagne (1968) is also relevant to this discussion of the developmental trend in children's grouping strategies. Gagne refers to intellectual development in his "Cumulative Learning Model". The model indicates that individuals who have not learned certain lower-level relationships, S-R connections, chains or multiple discriminations could not be able to acquire a higher-level capability of forming concepts, sets or rules. Gagne (1968, p. 189) contends that stages of development are not related to age, except in the sense that learning takes time. The author finds himself in essential agreement with Gagne's model but wishes to include the observations of Vygotsky (1962, p. 58-59) that the ability to form concepts doesn't simply evolve but is dependent on the child being presented tasks which

require him to use words in concept formation. The environment must present new tasks so as to make demands on the child and to stimulate his intellect if the child's thinking is to reach the highest stages.

CHAPTER III

EXPERIMENTAL DESIGN

PILOT PROJECT

Evanechko's (1970) logical-semantic relations were categorized into twenty-four types of word definitions. Ideally, therefore, the WDS should have required subjects to sort definitions representing all twenty-four categories. The initial version of the WDS consisted of three parallel sets containing 48 examples from Evanechko's list (Appendix A). Each set contained two word definitions from each category (word definitions in Appendix A have been arranged so that the six examples chosen from each category are listed first). The six examples chosen from each category were picked because they seemed to be the best illustrations of the principle or rule for categorization.

Individuals, both adults and children, were asked to sort the definitions from a set into groups containing similar definitions. While they were doing the task, they were encouraged to verbalize their grouping strategy. From the verbalized grouping strategies it was made obvious that several major adjustments were needed.

To present the subjects with a theoretical partition of twenty-four categories was too unwieldy. Each subject required a huge physical area for sorting; the subjects could not keep track of their many different reasons for sorting and with only two examples of each theoretical category available there were not enough examples for the

subjects to obtain satisfactory closure on their categorizations. In most cases confusion and disillusionment resulted.

It was decided to increase the number of examples available from each theoretical category but also to decrease the number of categories represented within the set an individual had to sort. Since Evanechko (1970) established five logical groupings of the categories (Table 2), it was decided to present each sorter with a theoretical partition consisting of five categories (in one of the 5 sets only four categories were available) with each containing 6 examples.

It was also noted from the initial project that in simplifying the sorting task most of the individuals divided the examples into two piles, one containing definitions with single word definers (categories 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 15, 16 and 22) and the other pile containing definitions with multiple word definers (categories 12, 13, 14, 17, 18, 19, 20, 21, 23 and 24). After obtaining the two piles the subjects then sorted them independently.

In the analysis of Evanechko's data a similar result can be noted. Table 3 is a tabulation of the number of categories that each category was preferred to (Evanechko and Maguire, 1971, p. 6). If no particular category is prefered over the others then it would be expected that each category would receive an average preference value of 12. Table 4 is a summary of the results obtained when the average preference values for the different subsets of Table 3 are calculated. This result would tend to indicate that Evanechko's subjects used the dimension of "length of definers" in helping to decide which definitions were "better".

TABLE 2

EVANECHKO'S LOGICAL GROUPING OF CATEGORIES

I Similarity	II Relation
1. Synonym	4. Coordinate
2. Similarity	5. Attribute
3. Superordinate	6. Contrast
9. Whole-part	15. Free Association
10. Part-part	16. Connotation

III Action	IV Class Membership
7. Action-of	19. Extension of a Class
8. Action-upon	20. Denotation in Context
11. Common-use	22. Generic Definition
12. Use-of	23. Class Membership Implied
13. Repetition	24. Intension of a Class

V Explanation
14. Contiquity
17. Analysis
18. Synthesis
21. Ostensive Definition

TABLE 3

PREFERENCES OF CATEGORIES

Category	No. of categories over which category was chosen	
	Grade 5	Grade 8*
1. Synonym	19	21
2. Similarity	9	11
3. Superordinate	11	11
4. Coordinate	7	7
5. Attribute	13	13
6. Contrast	10	9
7. Action-of	10	11
8. Action-upon	5	4
9. Whole-part	8	12
10. Part-part	4	3
11. Common-use	5	6
12. Use of	17	15
13. Repetition	9	9
14. Contiguity	14	14
15. Free Association	8	6
16. Connotation	1	0
17. Analysis	18	19
18. Synthesis	15	15
19. Extension of a Class	16	19
20. Denotation in Context	11	10
21. Ostensive Definition	21	19
22. Generic Definitions	11	9
23. Class Membership Implied	15	15
24. Intension of a Class	19	19

(*Total of this column is 277 and should be only 276, but error is in Evanechko's original data.)

TABLE 4

PREFERENCE OF MULTIPLE DEFINERS AS COMPARED TO SINGLE WORD DEFINERS

	Single word definers	Multiple words definers	Average preference values
Grade 5	8.6	15.5	12
Grade 8	8.8	15.4	12
Combined Groups	8.7	15.45	12

In revising Evanechko's grouping of the categories the "length of definers" were taken into consideration. Another factor under consideration during the revision was the potential for confusion between the categories. It was observed from the verbalizations made by sorters that they often did not delineate between categories 3 and 22 (Superordinate and Generic Definitions), between categories 4, 10 and 15 (Coordinate, Part-part and Free Association), between categories 5 and 7 (Attribute and Action-of) and between categories 13 and 20 (Repetition and Denotation in Context). It was decided to place those categories which some of the sorters found undistinquishable in the same set.

Table 5 gives the revised grouping of the categories. Three criterions were used in the revision. (1) Categories containing single word definers and categories containing multiple word definers were not placed in the same set. Set A, B and C contain categories of word definitions with only a single significate. All the definitions

TABLE 5

REVISED GROUPING OF CATEGORIES

Set A	Set B
1. Synonym	4. Coordinate
2. Similarity	6. Contrast
3. Superordinate	15. Free Association
9. Whole-part	16. Connotation
22. Generic Definition	10. Part-part

Set C	Set D
7. Action-of	14. Contiquity
8. Action-upon	17. Analysis
11. Common-use	18. Synthesis
5. Attribute	21. Ostensive Definition
	12. Use-of

Set E
19. Extension of a Class
20. Denotation in Context
23. Class Membership Implied
24. Intension of a Class
13. Repetition

contained in Set D and E have multiple significates. (2) If there appeared to be a potential for confusion between certain categories then these categories were placed in the same set. (3) The Evanechko's (1970) original logical grouping of the categories was maintained where possible.

By comparing Table 5 to Table 2 it can be noted that the revision resulted in the shifting of usually only one category from one set to another. Set A closely corresponds to Logical Grouping I; Set B closely corresponds to Logical Grouping II; Set C closely corresponds to Logical Grouping III; Set D closely corresponds to Logical Grouping V and Set E closely corresponds to Logical Grouping IV.

The six chosen examples from each category were placed in their respective groupings and the resulting five sets (Table 6) consisting of 30 (24 in Set C) randomly arranged definitions were used as the testing instrument for the WDS. A standardized introduction and directions to sorters, which was to be presented to explain the task to the subjects was prepared. The fifth and eighth grade students from an Elementary-Intermediate School were used in a pilot project for which the main objectives were to evaluate the sets and to establish a standardized introduction for the survey. The presentations to both grades were taped and these recordings were later used to make adjustments and improvements to the introduction.

The distribution of sets among the subjects was arranged so that no adjacent subjects would be given identical sets to sort. Conditional to the physical arrangement of classrooms this procedure

TABLE 6

THE FIVE SETS OF DEFINITIONS USED IN WORD DEFINITION SURVEY

	Set A		Set B		Set C
1.	uncooked - raw	1.	thirsty - hungry	1.	baby - rattle
2.	broom - handle	2.	hot - cold	2.	plumber - wrench
3.	adult - grown up	3.	chair - table	3.	sweep - floor
4.	dog - collie	4.	knife - fork	4.	diamonds - expensive
5.	hungry - starving	5.	safely - home	5.	turtle - slow
6.	good - better	6.	pencil - pen	6.	crocodile - swim
7.	dessert - pie	7.	unprotected - weak	7.	cat - purr
8.	basketball - game	8.	sit - down	8.	rabbit - hop
9.	flashlight - battery	9.	incorrect - bad	9.	baby - cry
10.	fish - salmon	10.	pedal - handlebars	10.	pilot - airplanes
11.	damp - wet	11.	beets - peas	11.	lion - roar
12.	vacant - empty	12.	carry - heavy	12.	throw - ball
13.	hand - finger	13.	fins - gills	13.	flame - hot
14.	hard - difficult	14.	hard - easy	14.	lemon - sour
15.	well - perfectly	15.	harmless - soft	15.	dog - bark
16.	apple - fruit	16.	pistol - rifle	16.	mouse - small
17.	bird - robin	17.	high - up	17.	play - piano
18.	beetle - insect	18.	listen - quiet	18.	farmer - tractor
19.	small - tiny	19.	tall - short	19.	soldier - rifle
20.	tree - branch	20.	modern - good	20.	elephant - heavy
21.	steal - rob	21.	old - young	21.	wash - hands
22.	water - liquid	22.	first - last	22.	student - pencil
23.	cool - cold	23.	unexplored - dangerous	23.	eat - apple
24.	vegetable - carrot	24.	arm - head	24.	chew - gum
25.	bicycle - wheel	25.	collar - sleeve		
26.	daffodil - flower	26.	oranges - apples		
27.	animal - deer	27.	wall - floor		
28.	equal - same	28.	wet - dry		
29.	book - page	29.	yolk - eggshell		
30.	mushroon - plant	30.	royal - strong		

Set D

1. loosen - to make less tight
2. memorize - learn and remember something
3. unlock - when you open the lock
4. camera - for taking pictures
5. lengthen - make a thing longer
6. interfere - when you get in the way
7. pebble - found lying on the ground
8. shotgun - for shooting
9. practice - do again and again
10. egg - from a chicken
11. moan - to make a low sound as in pain
12. tickle - you make someone laugh
13. rule - to control people
14. stove - found in a kitchen
15. iceberg - from a glacier
16. perform - when you do something
17. elect - when you choose by voting
18. knife - it has a blade
19. sparkplug - it has to do with the motor
20. bracelet - hangs at the wrist
21. scissors - for cutting
22. brag - you talk about yourself
23. fruit - from an orchard
24. dock - where ship ties up
25. envelope - for putting letters in
26. eyeglass - for helping to see better
27. fishhook - it is attached to a line and rod
28. apple - grows on a tree
29. ambulance - for carrying sick people
30. comma - placed in a sentence

Set E

1. business - stores and garages
2. coast - edge of land by an ocean
3. blind - a blind person
4. lullaby - song for putting a baby to sleep
5. surrender - surrender or be caught and killed
6. bulldog - a kind of dog
7. cheaply - buying cheaply saves money
8. crime - stealing or killing
9. drink - a drink of water
10. dairying - milk and butter
11. garage - a building for cars
12. dictionary - sort of a word book
13. bloody - a bloody knife
14. ring - ring the bell
15. community - people and homes
16. doughnut - small cake with hole
17. seaman - ships and sailing
18. thicken - thicken the gravy by adding more flour
19. brand-new - a brand-new car
20. refreshments - like something to eat
21. aspirin - drug for curing headaches
22. disobey - don't disobey, do as I say
23. bravely - act bravely
24. grin - a kind of smile
25. bomber - a kind of large airplane
26. sharpen - sharpen the knife till it cuts well
27. lumber - wood for building
28. stool - a sort of chair
29. farming - crops and animals
30. enlarge - enlarge the hole with this shovel

was followed throughout the gathering of data. Table 7 shows the distribution of data collected for the pilot study.

TABLE 7

DATA COLLECTED FOR PILOT PROJECT

	Set A	Set B	Set C	Set D	Set E	Total
Grade 5	6	5	7	6	5	29
Grade 8	6	6	5	6	5	28
Total	12	11	12	12	10	57

The visual analyses of the data appeared very satisfactory and it was decided to proceed with the study. The format which was to be used in the introduction to WDS (Appendix B) was finalized. No detailed analyses were performed on the data collected for the pilot study since initial trends may have helped to intensify "experimenter outcome-bias" (Rosenthal, 1963).

THE POPULATION

Permisssion was obtained from the Department of Instruction of the Edmonton Separate School Board to approach the principals of the schools within the system to elicit their cooperation in administering the WDS to their eleventh, eighth and fifth grade students. The survey

was administered to the total fifth grade population within two elementary schools; the total eighth grade population within three junior high schools and all the students taking the regular eleventh grade Social Studies program within two high schools of the Edmonton Separate School System. The schools selected were considered by the author and a representative of pupil personnel service staff of the above school system to be representative of the criterion of socio-economic status for the total population of the system at the particular grade levels of interest. It is important for the reader to note that such use of representative subjects does not imply a desire for generalizability of the study.

Fifth and eighth grade subjects were chosen for the study so as to correspond to the grade levels used by Evanechko (1970). Eleventh grade subjects were used because it was felt that they would be capable of mature or adult logic. The survey was administered to the subjects in the latter part of May, 1971. Table 8 contains a summary of the distribution of the different sets among the subjects from the three grade levels. The subjects of the pilot project are not included in this distribution since after the pilot project substantial changes were made in the introduction and directions to sorters. Only the data collected from these 570 subjects were analyzed to obtain the results reported in Chapter IV.

TABLE 8

DISTRIBUTION OF SUBJECTS OVER GRADES AND TYPE OF SET SORTED

	Set A	B	C	D	E	Total
Grade 5	35	34	35	36	36	176
Grade 8	40	38	41	39	38	196
Grade 11	40	39	40	39	40	198
Total	115	111	116	114	114	570

ADMINISTRATION OF SURVEY

In most cases the survey was administered to the subjects within their own classrooms, but about two-thirds of the subjects from grades eight and eleven were administered the survey in "open-areas" or in large study halls where the numbers in the groups varied from 40 to 90. The author was the sole administrator of the survey with the exception of assistance from classroom teachers in distribution and collection of the instruments. Each subject was given a copy of the introduction, an answer sheet and one of the five sets of definitions. The definitions were printed on two by four inch cards. In each set the examples of word definitions were assigned a number from 1 to 30 (word definitions of Set C were assigned a number from 1 to 24). The word definition was placed on the front of a card and its corresponding

number on the back of the card. These numbers only served the purpose of identifying the randomly arranged word definitions (Table 6).

In giving directions to the sorters the author did not vary from the format of the introduction of the WDS with the exception of a short apology to the grade eleven subjects. The author explained to them that since the survey was being administered to grade five subjects the terminology used in the directions had to be very unsophisticated. The subjects were asked to follow the instructions, reading them silently while the surveyor read the instruction aloud and demonstrated the examples on a "flannel board". Demonstrating the different examples, which were included in the instruction, on a "flannel board" instead of a blackboard helped to maintain the standardization of the presentation since all materials were prepared before hand. It was felt that the "visual" display of the instructions would assure understanding, especially for the grade five subjects.

It was emphasized to the subjects that no questions were to be asked other than those dealing with directions given in the introduction. Further to this point, only individual questions were allowed; the author went to the sorter where the question was asked and answered quietly. Any questions dealing with "how" to sort the definitions were answered with the standard reply: "Please place the cards in sets so that all cards in a set have definitions that are similar."

Individual sets were secured with an elastic band and the definitions were always arranged numerically in the set before being

passed out to the subjects. The five different sets were passed out alternately which assured that equal numbers of the different sets were distributed among the subjects in a particular intact group and also adjacent subjects tended not to have identical sets to sort.

The subjects were asked to fill in their answer sheet (Appendix B) after they were finished their sorting task. Most questions asked by the subjects concerned this portion of the survey. Three types of data were requested on the answer sheet: (1) A vector of group designations to be used in determining the manifest partition of the sorted card set. (2) A number of multiple choice questions used to indicate sorter's grade and set membership; the degree of difficulty experienced by the sorter and the extent the subjects cooperated by making a valid attempt to categorize the word definitions. (3) A short paragraph designed to facilitate assessment of grouping strategies.

Each subject sorted his thirty cards into as many groups as he wanted to. He then numbered these groups consecutively. On the answer sheet was a numbered list of the cards and the subject indicated in which of his groups he had placed each word definition. The actual group designation numbers were not important; the information collected simply indicated which word definitions had been placed in the same group.

To facilitate the identification of the sets, the edge of the different sets were colored: Set A - yellow; Set B - red; Set C - black; Set D - brown and Set E - green. During the survey the sets

were identified by their color. Question one of the answer sheet asked the sorter to indicate his grade level and question four requested the identification of the set sorted. Question two dealt with degree of difficulty experienced grouping the word definitions and question three attempted to determine the degree of sorter's cooperation.

The information obtained in question five dealt with the number of groups used by the sorter to categorize the word definitions and the number placed in his largest and smallest group. Question six of the answer sheet requested the sorter to choose any one of his groups and to describe why he had decided that its word definitions were similar. These short paragraphs were used to obtain a cross section of the grouping strategies employed by the sorters.

No time limit was imposed on the sorting task but the total time never exceeded one hour. On the average fifteen minutes was required for the presentation of the introduction. The total time required for the survey to be completed once the directions had been given varied from ten to forty-five minutes. On the average subjects in grade eleven required the least time and subjects in grade five required the most time. Subjects sorting the sets containing the single word definers required on the average less time than subjects sorting the sets containing multiple word definers. Subjects sorting Set C required on the average the least overall sorting time.

UNINTENDED DETERMINANT OF EXPERIMENTAL RESULTS

The introduction of the subjects to the "test situation" required an average of 15 minutes and a standard format was used for all grade levels. The question that arises is that: Did the author's introduction and instructions to the subjects influence their grouping strategy and/or were the data collected a valid output by the subjects? Rosenthal (1963) points out that the act of observing (in this case instructing) may very well change the object of study.

The first objective of the introduction was to explain to the subjects what was expected of them. The subjects were to group definitions which were similar. Definitions can be similar because they deal with the same subject matter; they are defining the same parts of speech; they give meaning to words in the same way; etc. The author wanted the subjects to sort the definitions by concentrating only on the dimensions of similarity dealing with methods of defining (logio-semantic relations) and to ignore all other dimensions, but if their grouping strategies did not include references to logico-semantic relations or if these references were vague and undeveloped the author wanted them to use the strategy which was available to them. To perform the task the subjects had to be told how they were to decide if definitions were similar and yet it was desired that this "information" would not influence their previous grouping strategy.

Evanechko's points out that in dealing with novel stimuli, adaptive reactions "would make the individual note the familiar and

recognizable qualities of stimuli to maintain equilibrium of these stimuli" (1970, p. 22). Vygotsky (1962) made extensive experimentation dealing with the development of "scientific concepts" in childhood. He points out that the development of a new concept is very slow.

The author therefore takes the position that his introduction did not influence the grouping strategies of the subjects. In popular terminology "the subjects heard what they wanted to hear". If the instruction to group the definitions according to their similarity in method of giving meaning to words was a "novel concept" or a "meaningless concept" to the subjects, then they would most likely ignore the instruction and proceed to group the definitions as they perceived them to be similar.

The second objective of the introduction was to elicit and obtain the cooperation of the subjects so that they would perform the grouping task seriously and conscientiously. The question of whether this objective was realized will be dealt with in Chapter IV.

CHAPTER IV

ANALYSES, RESULTS AND DISCUSSION

ANALYSES

Latent Partition Analysis

The raw data from each subject consisted of a vector of K items, where K is equal to the number of definitions sorted and where the jth item in the vector consisted of the number assigned to the category in which the jth definition was sorted. The raw data from each of the N subjects from each grade level who were given identical sets to sort were combined to produce the $K \times K$ joint proportion matrix S. These S matrices were the imput data for the University of Alberta Division of Educational Research Services computer program, SCAL06. This program outputs Φ, $1 - \Delta^2$ and Ω.

There are fifteen grade by set combinations. S, Φ, $1 - \Delta^2$ and Ω for each combination are presented in Appendix C.

Cross Tabulations

For each set of definitions there are four different partitions available; Φ_T, Φ_{11}, Φ_8 and Φ_5. Cross tabulations (X_{ab}) matrices were constructed between the four different partitions of each set.

$$X_{ab} = \Phi_a \Phi_b'$$

The four different partitions and their six X_{ab} ($a = T$, 11 or 8; $b = 11$, 8 or 5) for each set are presented in Appendix D.

The (k, j)th entry of matrix X_{ab} is the number of items which occur in the kth category of partition a and which also occur in the jth category of partition b. A perfect cross tabulation exists between partition a and b if X_{ab} is a square matrix with only one entry in each row and in each column greater than zero. These cross tabulation matrices serve to produce a quick visual perspective of the degree of agreement between partitions of the same set.

Index of Agreement

The extent to which the four different partitions of each of the five sets agree with each other is required for research hypotheses 1 and 2. Evans (1970) proposed a measure which he called the index of agreement, A, to determine the degree of agreement between two categorizations of the same set of elements.

The largest element of row k in matrix X_{ab} is defined as the extent to which category k of matrix a is best reproduced by a category in matrix b. The largest element of column j in the matrix X_{ab} is defined as the extent to which category j of matrix b is best reproduced by a category in matrix a. All other elements in each row and in each column, other than the largest, are defined as components of disagreement. d is the total of all components of disagreement adding over both columns and rows. d_{max} is the total of all components of disagreement in the matrix X_{ab} when the elements of the matrix are adjusted so as to reflect maximum possible disagreement. Maximum possible agreement between two different partitions of the same

stimuli occurs when only one element of each row and each column of their cross tabulation matrix has a value greater than zero (only possible with a square matrix). Maximum possible disagreement occurs when all elements of the matrix have the same value, if fractional entries in X_{ab} are allowed, otherwise, Evans (1970, p. 389-391) gives a mathematical method of calculating *d_{max}.

Evans (1970) defines the index of agreement (or index of similarity) of categorization as:

$$A = 1 - \frac{d}{d_{max}}$$

The index, A, ranges from 0, representing no agreement to 1, representing complete agreement. Complete agreement is represented by a cross tabulation matrix with only one element greater than zero in each row and each column.

As an example, consider two categorizations or partitions of the same 30 stimuli, Φ_s and Φ_p. Table 9 gives four possible cross tabulations between Φ_s and Φ_p (X_{sp_1}, X_{sp_2}, X_{sp_3} and X_{sp_4}) showing varying degrees of agreement. In cross tabulation, X_{sp_1}, both partitions are indicated to have placed the stimuli in six identical groupings since there is only one element in each row or column of the matrix which has a value greater than zero. There are no components of disagreement and therefore $A_1 = 1$, which indicates complete agreement between the two categorizations.

In cross tabulation, X_{sp_2}, partition Φ_s has five categories and partition Φ_p has six categories. The elements of the matrix

*Evans' determination of d_{max} appears to be in error. See Appendix E for discussion. Correction for d_{max} has been used in this study.

TABLE 9

FOUR POSSIBLE CROSS TABULATIONS BETWEEN DIFFERENT PARTITIONS OF THE SAME STIMULI

$$X_{sp_1} \begin{bmatrix} 6 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 2 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 4 & 0 \\ 0 & 0 & 0 & 0 & 0 & 7 \\ 0 & 8 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 3 & 0 & 0 \end{bmatrix}$$

$d = 0$

$d_{max} = 48$

$A = 1 - 0 = 1$

$$X_{sp_2} \begin{bmatrix} 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 \end{bmatrix}$$

$d = 49$

$d_{max} = 49$

$A = 1 - 1 = 0$

$$X_{sp_3} \begin{bmatrix} 3 & 3 & 3 & 1 \\ 3 & 3 & 3 & 1 \\ 3 & 3 & 3 & 1 \end{bmatrix}$$

$d = 41$

$d_{max} = 41$

$A = 1 - 1 = 0$

$$X_{sp_4} \begin{bmatrix} 6 & 2 & 0 & 0 & 0 & 0 \\ 1 & 4 & 1 & 0 & 0 & 0 \\ 0 & 0 & 3 & 3 & 0 & 0 \\ 0 & 0 & 0 & 4 & 3 & 1 \\ 0 & 0 & 0 & 0 & 0 & 2 \end{bmatrix}$$

$d = 19$

$d_{max} = 49$

$A = 1 - 0.39 = 0.61$

reflect maximum possible disagreement and $A_2 = 0$. Similarly in cross tabulation X_{sp_3}, maximum possible disagreement is indicated between the two categorization and $A_3 = 0$.

A subjective appraisal of cross tabulation X_{sp_4} appears to indicate "fairly good" agreement between the two different categorizations. The calculated value of A_4 is 0.61 and this substantiates the initial subjective judgement.

RESULTS AND DISCUSSION

Difficulty of Doing Survey

Question two on the answer sheet asked the subjects to indicate their evaluation of the level of difficulty of the grouping task which they performed.

(2) I found this survey ( ) fun ( ) easy ( ) hard
( ) confusing ( ) way too hard, so I mostly guessed.

If the majority of subjects found the task too difficult or too confusing then attempts to interpret the collected data would be questionable. Results for question two are summarized in Table 10.

Subjects were instructed to check one or more answer(s), and therefore rows in Table 10 do not sum to the number of sorters. Sorters who indicated that they found the survey "way too hard, so I mostly guessed" are less than 2%. Thirteen of the subjects from grade eight who sorted set B found the survey "confusing". Of these thirteen, five indicated they also found it "fun", three indicated they also found it "easy", three indicated that they also found it both "fun" and "easy",

TABLE 10

SUMMARY OF RESULTS FOR QUESTION TWO
ON THE ANSWER SHEET

Grade	Sets	"I found this survey" fun	easy	hard	confusing	way too hard	blank	# of sorters
Five	A	31	18	5	5	0	1	35
	B	26	15	4	5	1	1	34
	C	29	20	1	5	1	2	35
	D	32	15	8	6	0	1	36
	E	26	9	5	7	1	3	36
	Total	144	77	23	28	3	8	176
Eight	A	24	29	0	7	0	1	40
	B	25	21	3	13	0	2	38
	C	26	30	0	2	0	3	41
	D	30	15	5	8	0	2	39
	E	25	20	4	7	1	3	38
	Total	130	115	12	37	1	11	196
Eleven	A	23	22	3	9	1	3	40
	B	21	18	3	11	0	2	39
	C	24	26	1	3	0	2	40
	D	22	18	4	10	2	3	39
	E	17	29	4	4	0	3	40
	Total	107	113	15	37	3	13	198

and two only indicated that they found the survey "confusing". It would appear reasonable to interpret these multiple answers as attempts by the sorters to be thorough in their evaluation. Some of the definitions of their set were "easy" to sort into groups while others were "confusing".

Subjects from the fifth grade were more apt to check that they found doing the survey to be "fun" (over 80%) than were subjects from the higher grades. Subjects from the eighth and eleventh grade tended to check that they found doing the survey to be "easy", which the author considers to be a more discriminating answer than "fun". If only a single response had been allowed, then the response "fun" would not exclude any of the other four possible responses, while, the single response "easy" would tend to exclude three of the remaining four possible responses. Also it was expected that a higher percentage of the subjects from the eighth and eleventh grade would find the survey "easy" as compared to the subjects in the fifth grade.

The answers given to question two would indicate that most subjects enjoyed doing the survey and that they did not find the task of sorting the definitions too difficult.

Cooperation of Subjects

The LPA model produces a hypothetical latent partition which underlies the manifest partitions. A basic assumption is that the manifest partition of each sorter results from a valid attempt on his part to categorize the items. The cooperation of the subjects is essential.

Question three on the answer sheet asked the subjects to indicate whether they made an honest attempt to sort the definitions.

(3) In doing this survey ( ) I did my best
( ) I just put anything down.

Results from question three are summarized in Table 11. These results would indicate excellent cooperation from subjects.

Research Hypotheses

Table 12 gives the index of agreement between the theoretical partition and the latent partitions of the three different grade levels for all five sets.

Hypothesis 1. The latent partition of definitions for each grade will relate to Φ_T.

(i) Φ_{11} will closely reflect Φ_T.

(ii) Φ_8 will closely reflect Φ_T.

(iii) Φ_5 will closely reflect Φ_T.

The index of agreement may range from 0, representing no agreement, to 1, representing complete agreement. Other then indicating that the index of agreement is gradational (an index of 0.6 indicates a "better" fit than an index of 0.5), Evans (1970) does not suggest what value is to be interpreted as "good". The first row of Table 12 reports the index of agreement between Φ_T and Φ_{11} for each of the 5 sets. These indexes range from 0.79 up to 0.94 and these values are interpreted as indicating very high agreement. Research hypothesis 1. (i) is accepted.

TABLE 11

SUMMARY OF RESULTS FOR QUESTION THREE ON THE ANSWER SHEET

Grade	Sets	I did my best	blank	anything down	Total
Five	A	32	2	1	35
	B	31	3	0	34
	C	29	5	1	35
	D	32	3	1	36
	E	31	4	1	36
	Total	155	17	4	176
Eight	A	37	2	1	40
	B	29	7	2	38
	C	38	3	0	41
	D	37	1	1	39
	E	32	4	2	38
	Total	173	17	6	196
Eleven	A	34	4	2	40
	B	34	5	0	39
	C	36	4	0	40
	D	36	3	0	39
	E	36	4	0	40
	Total	176	20	2	198

TABLE 12

INDEX OF AGREEMENTS BETWEEN DIFFERENT PARTITIONS OF THE FIVE SETS OF DEFINITIONS

Between	Sets				
	A	B	C	D	E
T&11	0.94	0.84	0.79	0.94	0.80
T&8	0.74	0.76	0.91	0.75	0.61
T&5	0.62	0.72	0.88	0.55	0.46
11&8	0.79	0.71	0.90	0.79	0.69
11&5	0.59	0.72	0.74	0.57	0.56
8&5	0.72	0.74	0.84	0.76	0.62

The second row of Table 12 reports the index of agreement between Φ_T and Φ_8 for each of the 5 sets. These indexes range from 0.61 up to 0.91 and these values are interpreted as indicating high agreement. Research hypothesis 1. (ii) is accepted.

The third row of Table 12 reports the index of agreement between Φ_T and Φ_5 for each of the 5 sets. These indexes range from 0.46 up to 0.88 and these values are interpreted as indicating good agreement. Research hypothesis 1. (iii) is accepted.

Hypothesis 2. The ability to attribute meaning to words is developmental.

(i) Φ_{11} will more closely correspond to Φ_T than will Φ_8.

(ii) Φ_8 will more closely correspond to Φ_T than will Φ_5.

(iii) Φ_8 will more closely correspond to Φ_{11} than will Φ_5.

Φ_T is taken to represent the logical partitioning of the definitions which would represent the latent partition underlieing the manifest partitions of mature adults. If the ability to attribute meaning to words is developmental than the subjects in the higher grades should classify the definitions into groupings most similar to Φ_T. The index of agreements, A should be greater between Φ_T and the Φ of the higher grades than for those between Φ_T and the Φ of the lower grades. In this survey, a developmental trend would be indicated if:

$$\text{Criterion I:} \quad A_{T\&11} > A_{T\&8} > A_{T\&5}$$

The index of agreement between the Φ's of successive grades should also

be higher than the index of agreement between the Φ's of distant grades:

$$\text{Criterion II:} \quad A_{11\&8} > A_{11\&5}$$

If it is taken that subjects from the eighth grade are midway between subjects from the fifth and eleventh grade on the continuum of ability to attribute meaning to words, then:

$$\text{Criterion III:} \quad A_{11\&8} \simeq A_{8\&5}$$

or

$$A_{11\&5} < A_{8\&5} \text{ and } A_{11\&5} < A_{11\&8}$$

Accepting the above criteria, the results of Table 12 would indicate a definite developmental trend in the ability to discriminate among kinds of definitions. Set C violates Criterion I and set B violates Criteria II & III. In all other cases the three criteria were met.

Set B & C produced uniformly high values for all of their index of agreements. This might indicate that these two sets were found to be very easy to categorize and, therefore, they would serve as poor discriminators of sorters' ability to separate types of word definitions.

A close examination of the groupings made of the definitions of set C by grade eleven sorters would indicate that their lower degree of agreement to Φ_T was caused by a tendency to over-classify. In the "Action-of" category they discriminated between auditory actions and physical actions (example: baby - cry versus rabbit - hop). Using the criterion of motion associated with the subject the inclusion of "turtle - slow" into the second grouping is easily understood. It also

appears that grade eleven sorters discriminated between "Attribute" of things as compared to "Attribute" of animals (example: flame - hot versus turtle - slow). Research hypothesis 2. is accepted.

Hypothesis 3. Subjects in higher grades will show more between-subjects consistency in grouping of definitions than will subjects in lower grades.

The (j, j) element, δ_{ji}, of diagonal matrix Δ_i measures diversity of item j for judge i. This diversity of item j is the probability of the item being included in two different manifest categories under independent repartition. The average for Δ_i^2, $\Delta^2 = N^{-1}\Sigma\Delta_i^2$, is the diagonal matrix with measures of average diversity of items for all judges. If judges show a high degree of consistency in grouping of items then the matrix Δ^2 would approximate the null matrix, and the matrix $(I - \Delta^2)$ would essentially become the identity matrix.

Appendix C contains the fifteen latent partitions (each of 3 grades sorted the 5 sets of definitions). $(1 - \delta_j^2)$ for each item is reported. The values of $(1 - \delta_j^2)$ could be used to indicate the degree of between-subjects consistency in grouping of definitions. The average of $(1 - \delta_j^2) = K^{-1}\Sigma(1 - \delta_j^2)$ will be used to indicate overall consistency of subjects in grouping all elements of their set. Table 13 lists the average of $(1 - \delta_j^2)$ for each of the fifteen latent partitions.

The trace of a square matrix is the sum of the entries on the

TABLE 13

AVERAGE OF $(1 - \delta_j^2)$ FOR THE FIFTEEN LATENT PARTITIONS

Set	Grade	Average of $1 - \delta_j^2$	# of Categories in L.P.	Av. # of Categories in M.P.	Variance
	5	.605	8	7.5	7.2
A	8	.681	6	5.7	5.8
	11	.727	6	5.6	4.9
	5	.552	8	7.1	9.7
B	8	.635	6	5.8	6.6
	11	.731	6	5.4	4.2
	5	.647	5	6.0	5.4
C	8	.822	5	4.6	1.3
	11	.819	5	5.0	1.8
	5	.500	8	8.4	20.0
D	8	.652	7	6.6	6.5
	11	.665	6	6.2	4.4
	5	.553	9	8.1	20.0
E	8	.564	6	6.1	9.6
	11	.623	6	6.2	10.4

main diagonal and the trace of a matrix is also equal to the sum of its latent roots. From the LPA model: $\Sigma = \Phi'\Omega\Phi + \Delta^2$, it is possible to show that the diagonal entries of $\Phi'\Omega\Phi$ are equal to the diagonal entries of $(I - \Delta^2)$. Therefore the trace of $(I - \Delta^2)$ will be equal to the sum of the L largest latent roots kept after iterating (L largest latent roots since there are only L latent categories). The average of $(1 - \delta_j^2)$ will be directly related to the number of categories in the latent partition and indirectly related to the number of manifest categories for each individual sorter. All else being equal the average of $(1 - \delta_j^2)$ would be expected to increase as the number of categories in the latent partition increases.

Table 13 also lists the number of categories in each latent partition and the average number of manifest categories used by each sorter. In all cases, excepting set C, the latent partition for grade five subjects had more categories than the latent partition for grade eight and eleven subjects.

Hypothesis 3. may be restated as:

(i) The average of $(1 - \delta_j^2)$ for grade eleven sorters will be greater than corresponding value for grade five sorters.

(ii) The average of $(1 - \delta_j^2)$ for grade eleven sorters will be greater than corresponding value for grade eight sorters.

(iii) The average of $(1 - \delta_j^2)$ for grade eight sorters will be greater than corresponding value for grade five sorters.

The results presented in Table 13 would favour accepting Hypothesis 3. In set C the average of $(1 - \delta_j^2)$ for grade eight sorters is greater than the corresponding value for grade eleven sorters. These values are both very large and are taken to indicate very high consistency among sorters.

If all sorters are consistent in the grouping of their definitions then it would be expected that the variance of the number of categories used by a group of sorters would be quite small. Table 12 shows that the variance for grade five sorters was considerably higher than the corresponding values for the grade eight and eleven sorters.

Hypothesis 4. Grouping strategies used by subjects at different grade levels will illustrate a developmental trend.

Actual manifest partitions of each sorter and the resulting latent partition for the particular group has been the object of inquiry. It has been demonstrated that subjects at higher grade levels have a latent partition more similar to the theoretical partition than do subjects at lower grade levels. Actual strategies or "reasons" used by individual sorters to group the definitions will now be scrutinized. Do subjects at different grade levels use the same basic grouping strategy but with varying degree of mastery OR do subjects at different grade levels use completely different strategies?

There are two approaches to the study of the process of grouping and sorting definitions. One approach is passive in nature and involves

reporting "what happens". Latent Partition Analysis would appear to be a viable technique which could be used in studies of this nature. The hypothetical latent structure for the subjects who sort the objects is produced from their actual manifest sortings.

A second approach assumes that sorts or partitions do not just happen, but that they are governed by certain rules, and that these rules are the result of certain rather complex transformations imposed on data by an active subject (Bruner, 1963). The grouping strategy used by the sorter is the object of study rather than the empirical examination of different partitions produced by individual sorters.

Question six on the answer sheet asked the subjects to explain the strategy which they used to form a particular group in their manifest partition.

> (6) Pick any one of your sets and explain how you decided that the definitions of that set were similar. Give the rule that you used to determine what definitions to include in that set.

Table 14 summerizes the results obtained from this question. Thematic, Complexes, or Superordinate Concepts, which Vygotsky (1962) and Bruner (1963, 1964) indicated to be typical of stages in concept forming ability development, were used to categorize the responses of the subjects.

An initial phase on the way to concept formation comprises many variations of a type of thinking that can be called thematic grouping. Definitions or key words are put together by virtue of participating

TABLE 14

CLASSIFICATION OF GROUPING STRATEGIES

Set	Grade	Left Blank or Meaningless	Thematic	Complexes			Superordinate Concepts		Total
				Associative Types	Key Rings	Multiple Groupings	Subject Oriented	Definition Oriented	
	5	4	0	5	0	1	14	11	35
A	8	3	0	0	0	0	8	29	40
	11	2	0	0	0	0	10	28	40
	5	5	2	5	0	0	9	13	34
B	8	0	0	6	0	0	3	29	38
	11	2	0	0	0	0	5	32	39
	5	4	1	8	0	0	7	15	35
C	8	1	0	1	0	0	12	27	41
	11	0	0	0	0	0	7	33	40
	5	3	0	18	2	2	1	10	36
D	8	2	0	8	0	0	2	27	39
	11	2	1	3	0	0	9	24	39
	5	1	2	14	0	1	6	12	36
E	8	1	0	14	1	0	4	18	38
	11	3	0	6	0	0	7	24	40
	5	17	5	50	2	4	37	61	176
All	8	7	0	29	1	0	29	130	196
	11	9	1	9	0	0	38	141	198

in a sentence or a little story. This form of grouping yields very beautiful structures that are as "uneconomical" as anything the subject could do with the stimuli. In an "economical" grouping strategy only one universal rule is used to account for all stimuli being included in the group. In thematic grouping *n* different rules or "justifications" are used to account for the *n* different stimuli placed together in the group.

Some examples of grouping by thematic, taken from the answers given to question six are:

> "One man is stealing and he is killing and the police said surrender because he was killing people with sharp knife and it was bloody" (Set E, grade 5). Grouped in this set were:
> crime - stealing or killing
> surrender - surrender or be caught and killed
> sharpen - sharpen the knife till it cuts well
> bloody - a bloody knife
>
> "Set 7 [In the introduction the term "set" was used instead of "group" since it was considered that the subjects would be more familiar with this term from their arithmetic or mathematic classes.] has to do with each other because your sparkplug is part of a car which you travel to go hunting with shotgun for hunting and the pebble is what your walking on in the bush" (Set D, grade 11). Grouped in this set were:
> sparkplug - it has to do with the motor
> shotgun - for shooting
> pebble - found lying on the ground

A second major phase on the way to concept formation comprises many variations of a type of thinking that is called thinking in complexes. In a complex, the bonds between the definitions placed in a particular group are concrete and factual rather than abstract and logical. Any factual quality present in the definition or its immediate surroundings (other definitions in close proximity) suffices

to include it in the group. Grouping strategies that illustrated thinking in complexes were sub-divided into:

Associative type: The child notes a factual relationship between two definitions. All other definitions of the group are related to this one factual relationship. Any bond between the nucleus and another definition suffices to make the sorter include it in the group and to designate it by the common "family name". Some examples of grouping by associative type, taken from the answers given to question six, are:

> "Set 1 is about eating at the table" (Set B, grade 5). Grouped in this set were:
>
> thirsty - hungry   hot - cold
> chair - table   knife - fork
> sit - down   beets - peas
> oranges - apples

> "Set no. 7. Because they are all very expensive and they cost lots of money to own and operate" (Set C, grade 8). Grouped in this set were:
>
> diamonds - expensive   pilot - airplanes
> farmer - tractor   play - piano

> "Set 1 - hunting or camping out. shotgun - used as weapon. fishhook - when camping you fish. camera - taking pictures of your outing. knife - weapon - useful instrument. tickle - deals with laughter & enjoyment one receives when camping" (Set D, grade 11). Grouped in this set were:
>
> camera - for taking pictures
> shotgun - for shooting
> tickle - you make someone laugh
> knife - it has a blade
> fishhook - it is attached to a line and rod

Key rings: One definition is taken as the key and all the other definitions in the group are included because they process an attribute in common with the key definition. Definitions are included in the group because of their apparent relationship to the key. Different attributes of the key may be used to link it with each of the other

definitions and therefore these other definitions may or may not be related to each other. Some examples of grouping by key rings, taken grom the answers given to question six, are:

> "I picked set 7 the first card I got was interfere I also picked pebble because I thought a pebble would interfere, I picked iceberg because icebergs interfere with ships because ships sometimes crash into icebergs" (Set D, grade 5). Grouped in this set were:
>
> interfere - when you get in the way (KEY)
> pebble - found lying on the ground
> iceberg - from a glacier

> "I'm talking about set number 5 dairying, drink, farming farming is where dairying takes place, and drink is what you get from dairying" (Set E, grade 8). Grouped in this set were:
>
> dairying - milk and butter (KEY)
> farming - crops and animals
> drink - a drink of water

Multiple groupings: Instead of one general rule being used to include definitions into a group, several rules are used. A different rule may be used to justify the inclusion of each definition. An example of grouping by multiple groupings, taken from the answers given to question six, is:

> "scissors are very sharp, a knife can cut you. a stove is very hot. envelopes are to put letters in. fishhook are to put on lines. apples grow. chicken lay eggs" (Set D, grade 5). Grouped in this set were:
>
> egg - from a chicken
> stove - found in a kitchen
> knife - it has a blade
> scissors - for cutting
> envelope - for putting letters in
> fishhook - it is attached to a line and rod
> apple - grows on a tree

Considerably more sophisticated than thematic and complexes are superordinate concepts, in which one universal rule of inclusion accounts for all the definitions in the set. Both Vygotsky (1962) and

Bruner (1963, 1964) indicated that true concepts or superordinate concepts could be formed at varying levels of sophistication. Vygotsky's final stage of adult thinking was characterized by the use of subjective, factual, and logical reasoning. Bruner's superordinate concepts were characterized in terms of the syntactic structure of the defining or universal rule for inclusion, but the focus of attention of the sorter was also an aspect for grouping. The sorter is free to use perceptual features or functional features as attributes to base his criterion for grouping the definitions.

Many of the rules reported by the sorters as their reason for grouping several definitions incorporated the criterion that a universal rule of inclusion be used to determine similarity and thus their answers were classified as examples of superordinate concepts, but due to the limiting quality of their focus they failed to group the definitions appropriately. For this reason the answers which reflected superordinate concepts were sub-divided into those which were subject or word oriented and into those which were correctly definition oriented.

Subject oriented: The word being defined or a key word from the body of the definition is taken and similarity is judged by focusing only on the quality or attributes of this single word. The sorter concentrates on what type of word is being defined and places the cards into sets of similar subject matter. Some examples of grouping while being subject orientated, taken from the answers given to

question six, are:

"In one set I put all the things that remind me of food. If it has something to do with food I put it in that set" (Set E, grade 5). Grouped in this set were:

drink - a drink of water
dairying - milk and butter
doughnut - small cake with hole
refreshments - like something to eat

"I put animals in one set and I thought the animals should go in one group" (Set C, grade 8). Grouped in this set were:

turtle - slow
cat - purr
lion - roar
mouse - small
crocodile - swim
rabbit - hop
dog - bark
elephant - heavy

"In set 4 the rule used was that the things listed had to do with land and or water" (Set D, grade 11). Grouped in this set were:

pebble - found lying on the ground
iceberg - from a glacier
dock - where ship ties up
fishhook - it is attached to a line and rod

Definition orientated: The sorter concentrates on the whole definition and places the cards into sets so that all cards in a set have definitions that are similar. The universal rule of inclusion accounts for all definitions in the set by relating how the defining words give meaning to the respective subjects of the definitions in similar manner. Some examples of grouping while being definition oriented, taken from the answers given to question six, are:

"In one of my sets (set 2) which consisted of 11 cards I used this rule: I looked at both words and if one of the words was a type of the other (eg. bird - budgie) I would pick it for this set" (Set A, grade 5). Grouped in this set were:

dog - collie
basketball - game
apple - fruit
beetle - insect
daffodil - flower
dessert - pie
fish - salmon
bird - robin
vegetable - carrot
animal - deer
mushroom - plant

"I picked set no. one because it is the set of opposites. Each word on the left has the opposite meaning than the one on the right" (Set B, grade 8). Grouped in this set were:

hot - cold	hard - easy
tall - short	old - young
first - last	wet - dry

"Set 3.-- I decided that these definitions were similar because all the words on the left are nouns and the words on the right tell or describe the noise or sound that they make" (Set C, grade 11). Grouped in this set were:

cat - purr	baby - cry
lion - roar	dog - bark

The classification of the paragraphs written to describe the grouping strategy was carried out by the investigator. The paragraphs were examined and classified on four separate occasions. The results recorded in Table 14 are the final tabulations. Most of the paragraphs were easy to classify, but some were classified by making a subjective decision based on the author's interpretation of what the sorter was trying to express.

Only five sorters, all from grade five, left question six of the answer sheet blank and twenty-eight of the sorters' answers were judged to be meaningless and impossible to categorize. Some examples of answers judged to be meaningless are:

"I put these together because they all go together" (Set D, grade 5).

"In my first set I put the cards there because they all defined a word" (16 cards were placed in this set) (Set E, grade 8).

"Set 1 had 1 member because it is not a definite definition. The other sets were logical and this card would not fit with any of the other groups" (Set E, grade 5).

The results recorded in Table 14 illustrate that the proportion of subjects using definition-oriented concepts in their grouping

strategies were greater at the grade eleven level and lowest at the grade five level. The proportion of subjects using thematic or complexes in their grouping strategies were greatest at the grade five level and lowest at the grade eleven level. Table 15 is taken from Table 14 and shows the proportion of subjects from each of the grade levels of interest using thematic, complexes or superordinate concepts in their grouping strategies.

TABLE 15

PROPORTION OF SUBJECTS USING THE THREE THEORETICAL TYPES OF GROUPING STRATEGIES

Grade	Thematic		Complexes		Superordinate	
	freq.	prop.	freq.	prop.	freq.	prop.
5	5	0.028	56	0.318	98	0.557
8	0	0.000	30	0.153	159	0.811
11	1	0.005	9	0.045	179	0.904

Hypothesis 4. is accepted. Grouping strategies used by subjects at different grade levels illustrated a developmental trend. There is a trend for grade eleven's to use more definition oriented explanations than younger children do. The results would indicate a steeper slope between grade five and eight than between grade eight and eleven. These findings would be in agreement with Vygotsky's (1962) and Bruner's (1964) observations that the developmental process which eventually results in concept formation begins in earliest childhood and ripens in late adolescence.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

SUMMARY

The main purpose of this study was to ascertain if children of different grade levels recognize the uniqueness of each one of Evanechko's (1970) twenty-four categories of logico-semantic relations. It was desirable to determine if one method of ascribing meaning to a word is perceived by children to be distinct from other methods. A corollary, the ability to accrue meaning to words is developmental, of this question was also investigated.

A population of 570 subjects from the fifth (176), the eighth (196) and eleventh (198) grade within six schools representing a cross-section of the grade levels of interest from the schools of the Edmonton Separate School System were given the task of grouping different examples of word definitions into distinct categories containing examples of different words being defined in the same manner. Each subject was given a copy of The Word Definition Survey (WDS) which consisted of an introduction, an answer sheet and one of five sets of definitions. The five sets consisted of 30 (24 in one of the sets) randomly arranged definitions. The main types of data collected on the answer sheet consisted of: (1) A vector of designations to be used in determing the manifest partition of the sorted card set. (2) A short paragraph designed to facilitate assessment of the sorter's grouping strategies.

Wiley's (1967) Latent Partition Analysis (LPA) was the technique used to recover the categories of word meaning which were recognized as distinct types by the subjects. To determine the efficacy of LPA as a quantitative tool in experimental work directed at the study of conceptual structures was a secondary purpose of this study.

The grouping strategies of the children at the three different grade levels were scrutinized. A classification system similar to one recommended by Vygotsky (1962) and Bruner (1963, 1964) was used to help indicate a developmental trend in the grouping strategies of the subjects.

CONCLUSIONS

The major hypothesis was that the latent partition of word definitions obtained for each grade level would correspond to the theoretical partition. This hypothesis was accepted for all three grade levels.

Evans (1970) index of agreement was used to determine the degree of agreement between the different latent partitions and the theoretical partition. The degree of agreement was found, in almost all cases, to increase with grade level and this was taken to illustrate a developmental trend in the subject's ability to discriminate between types of definitions. Subjects in the higher grades were also found to show more between-subjects consistency in grouping of the definitions then did subjects in the lower grades.

The grouping strategies used by the subjects of the different grade levels were found to illustrate a developmental trend. There was a trend for grade eleven subjects to use more explanations of their grouping strategies which reflected the categorization rules of the logico-semantic relations than did the younger children. The proportion of subjects using thematic or complexes as their grouping strategies were greatest at the grade five level and lowest at the grade eleven level.

RECOMMENDATIONS

One purpose of the present study was to evaluate the efficacy of the Latent Partition Model in recovering the theoretical latent partition of a set of stimuli for different groups of subjects in order to study the similarities and dissimilarities between their conceptualizations of how the stimuli "fitted" together. Evans (1970) suggests that "Hypotheses of the kind that different treatments result in different concepts may be rephrased in terms of different treatments resulting in different categorizations" (p. 392). Hess and Johnson (1971) suggested the use of LPA as an aid to curriculum and instructional decision making. They indicate that "sorting tasks provide a means to identifying processes basic to cognitive behavior" (p. 5) and they used LPA to help identify the changes in cognitive structure after a semester of college instruction.

In the present study a theoretical classification of word definitions used by children was given emperical justification. The

similarities and dissimilarities of the latent partitions of sets of examples of definition types to the theoretical partition was used to substantiate the opinion that the ability to discriminate between types of definitions would increase with grade level (as the individuals were presented by their environment with new and varied learning experiences).

In sequence with the sorting tasks the subjects were asked to write out an explanation of their grouping strategy. It is felt by the author that this technique helped to give qualitative meaning to the subjects' categories of word definitions. The lowest grade level of the subjects tested was the fifth grade and it was felt by the author that the grouping strategies of these subjects would not include examples of "heaps" which Vygotsky (1962) and Bruner (1963, 1964) found to predominate in the conceptualizations of learners in the very early stages. It was contended that in order to write sentences and paragraphs a subject would have to be beyond the stage in their conceptual development in which their grouping strategy would include "heaps". This hypothesis could be tested by encouraging the sorters to verbalize their thinking while sorting sets of stimuli and to have these verbalizations recorded on tape. A series of individual case studies would seem to be an effective way of obtaining insight into the grouping strategies employed by very young learners. In the initial evaluation of the sets of word definitions the author found both the verbalizations of children and also those of adults to be very useful in setting the final format of the WDS.

The major purposes of Evanechko's (1970) study were to investigate the nature of semantic processes and the concept of semantic space. For this purpose he developed the Semantic Feature Test (SF test) which required the subjects to choose the "better" definition from a pair. The SF test consisted of 276 paired comparison items, each definition illustrative of one of the logico-semantic relations. The 276 paired comparison items were formed by comparing an example from each of the twenty-four categories of logico-semantic relations with each of the remaining twenty-three categories. To provide variety so as to maintain the subjects' interest he developed twenty-three different examples for each category, a new example for each paired comparison item a given category was included in.

Considering the results obtained from the present study the use of different examples to represent each category of logico-semantic relations may have introduced confounding variables which affect the choice of the subjects in deciding which of the pair of definition types was "better". Evanechko intended to define the dimensionality of the subjects' theoretical semantic spaces with reference to the logico-semantic relations which they preferred. It is the present writer's contention that at least two extraneous variables, other than the intended independent variable of type of logico-semantic relations, may have affected the choices of "better" definition. These two extraneous variables could be (1) the variety in examples used to represent each category of logico-semantic relations and (2) the subject matter of the word being defined.

If paired comparison items were formed by comparing different examples of word definitions illustrative of the same category of logico-semantic relation it would be possible for the subjects to select the "better" definitions from the set of pairs. Between the two examples "steal - rob" and "equal - same" (the first two examples from the category of Synonym), a subject could choose the second example as the "better" of the pair.

If two different examples of word definitions are taken from two different categories of logico-semantic relations it is possible to form four combinations of paired comparison items. If presented with one of the combinations a subject could select a word definition as the "better" of the pair, but, if presented with one of the other combinations the subject might select an example from the opposite category as the "better" of the pair. Taking two different combinations made up of the first two word definitions from the categories of Synonym and Similarity, the following two paired comparison items can be formed:

1. (a) steal - rob
   (b) hungry - starving

2. (a) equal - same
   (b) small - tiny

In the first example the (b) member of the pair, illustrative of the category of Similarity, could be selected as the "better". In the second example the (a) member of the pair, illustrative of the category of Synonym, could be selected as the "better".

In the present study it was noted that some of the subjects oriented on the subject matter of the word being defined. Depending on the learning history of the child some examples from a given category of logico-semantic relations could act as a "positive" or

"negative" stimulus. Using the procedure of the above paragraph it could be shown that the subject matter of the word being defined could serve as a confounding variable in the selection by subjects of which is the "better" pair in a particular paired comparison item.

It could prove interesting to repeat Evanechko's (1970) study while eliminating, to the extent feasible, the possible affects of using different examples and different subject matter of the words being defined. Some of the logico-semantic relations can be applied only to nouns while others to verbs, adjectives or adverbs. Table 16 lists a possible set of twenty-four word definitions illustrative of the twenty-four logico-semantic relations which attempts to incorporate the two above mentioned restrictions. Many of the subjects of the present study indicated that they found any definition dealing with food most pleasing and so this was the subject matter chosen for the word definitions. From the twenty-four examples, each representing a logico-semantic relation, 276 paired comparison items could be formed. In these items the predominate source of variation would be the categories of logico-semantic relations being compared.

TABLE 16

A SET OF WORD DEFINITIONS, EACH ILLUSTRATIVE OF A LOGICO-SEMANTIC RELATION

1. uncooked - raw
2. hungry - starving
3. fruit - apple
4. knife - fork
5. lemon - sour
6. sour - sweet
7. apple - grows
8. eat - bread
9. apple - peel
10. meat - potatoes
11. baker - bread
12. orange - for eating
13. ripe - a ripe banana
14. apple - grows on a tree
15. hungry - eat
16. hungry - bad
17. cook - to prepare food for eating
18. fruit - from an orchard
19. dairying - milk and butter
20. thicken - thicken the gravy by adding more flour
21. drink - when you take a liquid into your mouth and swallow
22. apple - fruit
23. refreshments - like something to eat
24. doughnut - small cake with hole

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APPENDICES

APPENDIX A

Examples of Children's Word Definitions for the Twenty-four Categories of Logico-Semantic Relations

1. Synonym

steal - rob
equal - same
vacant - empty
adult - grown up
uncooked - raw
hard - difficult
big - large
active - lively
usual - regular
troubled - worried
awkward - clumsy
breezy - windy
disgraceful - shameful
hurriedly - speedily
singly - alone
surely - definitely
sadly - unhappily
again - once more
whole - complete
frequently - often
seldom - not often
cheerfully - happily
gradually - slowly

2. Similarity

small - tiny
hungry - starving
good - better
cool - cold
damp - wet
well - perfectly
smile - laugh
comfortable - very satisfied
bold - very brave
good - expert
trained - highly educated
slim - skinny
jump - leap
nice looking - beautiful
under - far below
gradually - at once
idly - lazily
great - excellent
often - hourly
long - stretched out
trot - gallop
soon - immediately
badly - terribly

3. Superordinate

bird - robin
vegetable - carrot
animal - deer
fish - salmon
dog - collie
dessert - pie
industry - factory
fruit - apple
furniture - sofa
building - skyscraper
farm - field
planet - Mars
science - chemistry
flavoring - vanilla
footwear - slipper
musical instrument - guitar
metal - gold
human - boy
grandparents - grandfather
crowd - man
flower - rose
direction - south
game - football

4. Coordinate

chair - table
beets - peas
knife - fork
pistol - rifle
pencil - pen
oranges - apples
necklace - earrings
sweater - jacket
pipe - cigar
statue - painting
oats - wheat
ring - bracelet
newspaper - magazine
mosquito - fly
scarf - mittens
comma - period
red - green
breakfast - supper
cap - hat
doughnut - muffin
shoes - boots
bulldog - husky
lantern - flashlight

5. Attribute

turtle - slow
lemon - sour
elephant - heavy
diamonds - expensive
flame - hot
mouse - small
whale - large
icecube - cold
plains - flat
skeleton - brittle
icebox - cold
peacock - colorful
mountain - immovable
mystery - strange
germ - invisible
cartoon - funny
artic - cold
hail - cold
cliff - rocky
liquid - wet
cracker - crisp
runway - long
swamp - wet

6. Contrast

hard - easy
wet - dry
hot - cold
tall - short
old - young
first - last
loud - soft
unhealthy - well
strong - weak
deep - shallow
early - late
serious - funny
splendid - awful
here - there
upward - downward
somewhere - nowhere
longer - shorter
excellent - terrible
later - earlier
perfectly - poorly
sooner - later
singly - as a group
silently - noisily

7. Action-of

dog - bark
baby - cry
crocodile - swim
lion - roar
rabbit - hop
cat - purr
hockey player - skate
bandit - rob
hunter - shoot
horse - gallop
insect - crawl
baby-sitter - watch
beaver - dive
housekeeper - cleans
children - play
pickpocket - steal
cripple - limp
borrower - ask
fire - burn
stream - gurgle
dice - roll
antelope - leap
blade - cut

8. Action-upon

sweep - floor
throw - ball
play - piano
eat - apple
chew - gum
wash - hands
eat - bread
wear - blouse
blow - harmonica
paint - picture
report - news
shorten - dress
sing - song
attack - enemy
love - friend
roam - road
celebrate - birthday
rejoin - group
test - skills
graze - grass
crack - egg
bake - break
borrow - money

9. Whole-part

hand - finger
book - page
tree - branch
bicycle - wheel
flashlight - battery
broom - handle
bird - wing
face - eye
shoe - heel
house - window
foot - toe
eyelid - eyelash
ship - anchor
body - belly
shotgun - trigger
eyeglass - lens
book - chapter
grain - oats
violet - petal
stream - rapids
envelope - flap
triangle - angle
album - picture

10. Part-part

wall - floor
arm - head
pedal - handlebars
collar - sleeve
fins - gills
yolk - eggshell
door - window
hand - leg
headlight - brake
foot - knee
hoof - tail
propeller - motor
window - roof
cup - bowl
caboose - boxcar
lung - heart
burner - oven
bulb - switch
trigger - barrel
engine - boxcar
page - cover
handle - spout
pocket - button

11. Common use

farmer - tractor
student - pencil
baby - rattle
soldier - rifle
pilot - airplanes
plumber - wrench
dog - bone
cripple - crutch
carpenter - nail
shoemaker - boots
doctor - drug
pupil - scribbler
baker - bread
scientist - microscope
logger - timber
sailor - ship
waiter - menu
jeweler - ring
thinker - ideas
postmaster - mail
Indian - tomahawk
banker - money
teacher - chalk

12. Use of

envelope - for putting letters in
scissors - for cutting
camera - for taking pictures
eyeglass - for helping to see better
ambulance - for carrying sick people
orange - for eating
acid - for eating things away
blanket - for covering
bumper - for protecting a car
ankle - for joining foot to leg
stereo - for playing records
bank - for saving money
galoshes - for wearing on your feet
horse - for riding
dice - for playing games
magnet - for picking up iron
saw - for cutting
suitcase - for travelling
shingles - for covering a roof
multiplication - for use in arithmetic
spool - for winding thread on
blotter - for drying ink
shotgun - for shooting

13. Repetition

drink - a drink of water
ring - ring the bell
bravely - act bravely
blind - a blind person
bloody - a bloody knife
brand-new - a brand-new car
tap - a tap on the wall
approach - approach the door
believe - believe in it
borrow - borrow something from him
brighten - brighten the color
beautify - beautify the room
assemble - assemble the parts
attach - attach the ends together
attract - attract his attention
beat - beat the others
often - too often is too much
quote - quote the words
mash - mash it down
begin - begin at the beginning
blond - a blond girl
bold - a bold man
arrange - arrange all the pieces

12. Use of

envelope - for putting letters in
scissors - for cutting
camera - for taking pictures
eyeglass - for helping to see better
ambulance - for carrying sick people
orange - for eating
acid - for eating things away
blanket - for covering
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beat - beat the others
often - too often is too much
quote - quote the words
mash - mash it down
begin - begin at the beginning
blond - a blond girl
bold - a bold man
arrange - arrange all the pieces

14. Contiguity

apple - grows on a tree
stove - found in a kitchen
comma - placed in a sentence
pebble - found lying on the ground
dock - where ship ties up
bracelet - hangs at the wrist
late - you can see by the clock
cartoon - found in comics
farmhouse - where farmer lives
farmyard - land surrounding a farmhouse
pianist - plays in a band
suitcase - found in trains and planes
electricity - carried by wires
scientist - works in a laboratory
paddle - moves a canoe
basement - goes under the house
train - runs on rails
mathematics - working with numbers
here - in this place
iceberg - floats in the ocean
branch - where the river divides
sliver - sticks in your finger
bomb - dropped on targets in battle

15. Free association

carry - heavy
listen - quiet
sit - down
high - up
safely - home
thirsty - hungry
enjoy - fun
happen - did
prepare - ready
belongs - yours
deceive - receive
bitter - sour
bright - light
hard - rock
pleasant - happy
slow - turtle
obey - yes
sadly - tear
usually - quickly
believe - tell
gleam - bright
crazily - dance
swift - fast

16. Connotation

royal - strong
modern - good
incorrect - bad
unprotected - weak
harmless - soft
unexplored - dangerous
immovable - strong
fantastic - dangerous
unequal - bad
certain - good
great - strong
pleasing - soft
playful - good
disloyal - bad
dishonest - bad
unafraid - good
unborn - soft
uncertain - weak
confess - good
unexpected - good
unclean - bad
love - good
unkind - hard

17. Analysis

rule - to control people
lengthen - make a thing longer
loosen - to make less tight
memorize - learn and remember something
moan - to make a low sound as in pain
practice - do again and again
mention - talk to others about something
shortly - happening in a little while
amuse - make smile and laugh
arrest - to take prisoner for wrongdoing
combine - put things together in groups
murmur - whisper to someone
openly - do in plain sight
invent - develop something new
perform - to act out a part
pretend - make-believe that something is real
earning - working to make money
refund - return money
order - tell other to obey
outstanding - important work
quit - to stop
roam - to wander about
sufficiently - having done enough

18. Synthesis

fruit - from an orchard
iceberg - from a glacier
fishhook - it is attached to a line and rod
egg - from a chicken
knife - it has a blade
sparkplug - it has to do with the motor
cones - from a pine
bunk - it has two levels
community - it has many people
cider - from apples
airline - it has passenger planes
bait - it attracts animals
bumper - part of a car
stub - part of ticket
cobweb - from a spider
fuel - it burns in a stove
thunderstorm - it brings clouds and rain
playpen - a baby's toys are found there
cookbook - it has many recipes
musician - he has an instrument
grain - from fields of crops
shampoo - it has suds
education - it needs schools and teachers

19. Extension of a class (Implication)

seaman - ships and sailing
farming - crops and animals
crime - stealing or killing
community - people and homes
dairying - milk and butter
business - stores and garages
bugs - beetles or flies
alphabet - A, B, C
baggage - suitcases and packages
furniture - chairs or tables
cosmetics - lipstick and powder
merchant - buys and sells
romance - love and kisses
sculpture - statues or stone animals
motor - gas and oil
jewel - diamond or ruby
jewelry - rings and bracelets
juggle - toss and flip
appearance - face and clothing
flavoring - vanilla and strawberry
mine - dig and burrow
skeleton - bones and skull
boating - sailing or rowing

20. Denotation in Context

sharpen - sharpen the knife till it cuts well
disobey - don't disobey, do as I say
enlarge - enlarge the hole with a shovel
surrender - surrender or be caught and killed
thicken - thicken the gravy by adding more flour
cheaply - buying cheaply saves money
bitten - bitten by a snake
invent - invent a new machine
shiver - shake and shiver in the cold
beyond - he went beyond the fence
shrink - shrink it down to size
dock - dock the ship at the pier
sneak - quietly sneak away
soften - pound the piece to soften it
stolen - stolen by robbers from the bank
support - it can support the weight
through - it went through the window
trample - crush and trample the grass down
attack - soldiers attack the enemy
finally - at last he finally went
forward - moving forward he advanced
generally - generally it is so
boost - boost it up to the top

21. Ostensive Definition

tickle - you make someone laugh
unlock - when you open the lock
brag - you talk about yourself
interfere - when you get in the way
perform - when you do something
elect - when you choose by voting
selfish - all for yourself
unfasten - you undo something
convince - you talk a person into believing
brave - when you show courage
drift - when you float along
blast - something which explodes at you
vanish - you see it disappear
wade - you walk in water
sign - you write your name
eagerly - you act because you like it
upstairs - when you climb the stairs
wander - you walk here and there
frequently - you do it often
completely - you finish your work
yawn - you open your mouth sleepily
gladly - you do something because you want to
sometimes - you do it now and then

22. Generic Definitions

water - liquid
basketball - game
beetle - insect
mushroom - plant
apple - fruit
daffodil - flower
scorch - burn
cup - dishes
pork - food
pamphlet - book
perch - a fish
vest - suit
window - glass
chisel - tool
grizzly - bear
giraffe - animal
cinnamon - flavoring
popular - tree
hippopotamus - animal
mosquito - insect
moth - insect
oyster - shellfish
submarine - ship

23. Class Membership Implied

stool - a sort of chair
refreshments - like something to eat
bomber - a kind of large airplane
dictionary - sort of a word book
bulldog - a kind of dog
grin - a kind of smile
cone - like an ice-cream cone
boar - a kind of a pig
arctic - like the north
globe - like a ball
elastic - like rubber
grove - like a small woods
silvery - like silver
liquid - like water
reflect - sort of give off light
memorize - sort of learn
lodge - like another home
clam - a kind of shellfish
jigsaw - a kind of puzzle
rodeo - a kind of contest
speedily - sort of quickly
horsefly - sort of a large fly
opera - a kind of music

24. Intension of a Class

doughnut - small cake with hole
coast - edge of land by an ocean
aspirin - drug for curing headaches
garage - a building for cars
lullaby - song for putting a baby to sleep
lumber - wood for building
sipped - drank a little at a time
notice - see and remember
advice - helpful information
album - book for pictures
alphabet - set of letters
gizzard - bird's second stomach
canal - man-made river
grandparents - parents of parents
glance - look at quickly
nostril - opening in the nose
blink - open and close eye quickly
cider - apple juice
brand - special mark
beaver - small furred animal
bomb - explosive material
bloodhound - breed of dog
whisper - soft sound

APPENDIX B

The Word Definition Survey

WORD DEFINITION SURVEY

This is a survey to find out how you look at the meanings of words. You will not be asked to sign your name to your answer sheet. The purpose of this survey is to compare how students at different grade levels (grade 5, 8 and 11) differ in the methods they use to give meaning to words.

Please try your best. There are no wrong answers. There are 5 different forms of this survey; your neighbours may have different forms.

Before starting, a few important ideas will be reviewed.

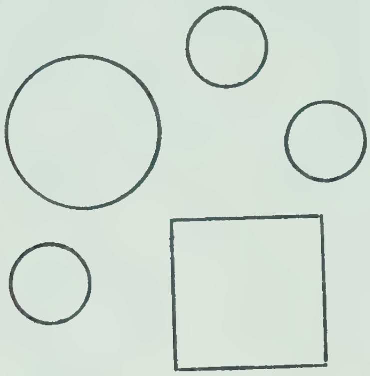
GROUPS AND SETS

A SET is any collection of similar objects. Below is a group of objects. Place these objects in sets so that the members in each set are similar.

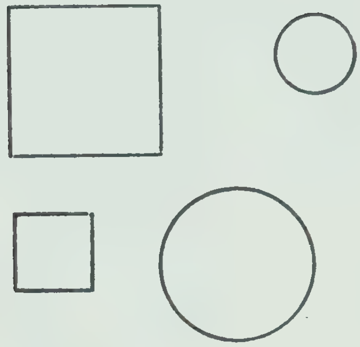
DEMONSTRATION ONE

(A)

SET 1



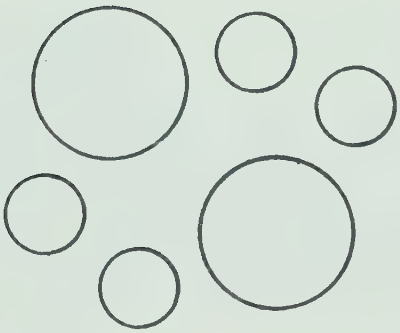
SET 2



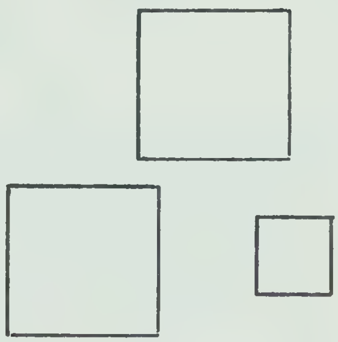
These are poor examples, since the members of each set do not seem to go together.

(B)

SET 1



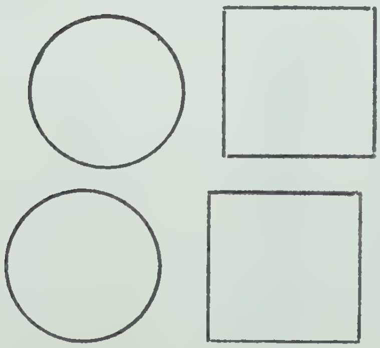
SET 2



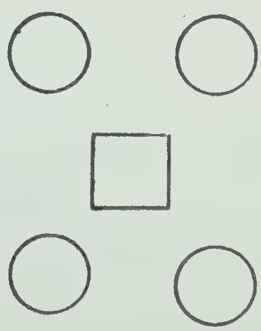
All the circles have been placed in SET 1 and all the squares have been placed in SET 2.

(C)

SET 1

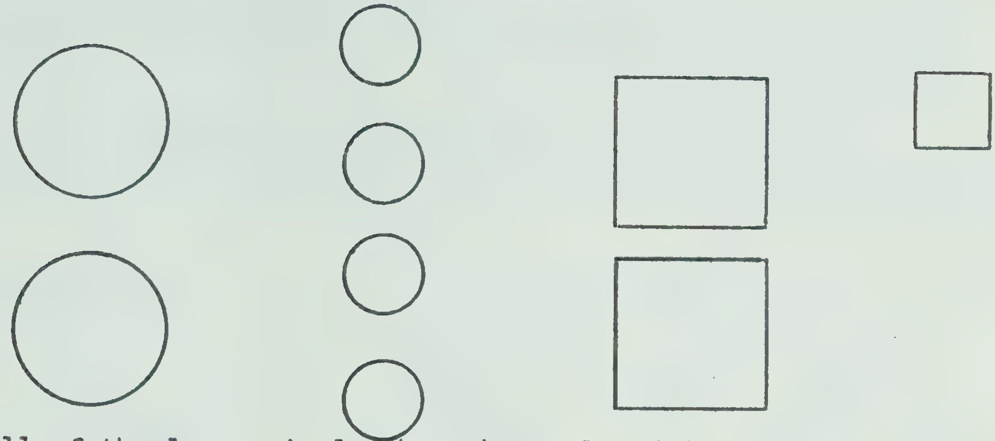


SET 2



All of the large objects have been placed in SET 1 and all of the small objects have been placed in SET 2.

(D) SET 1 SET 2 SET 3 SET 4



All of the large circles have been placed in SET 1, all of the small circles have been placed in SET 2, all of the large squares have been placed in SET 3, and the small square has been placed in SET 4.

SIMILAR DEFINITIONS

The definition of a word is given in a dictionary. A definition tries to explain or give meaning to a word. There are many ways to explain a word. Definitions are similar, not because they define the same word, but because they define different words in the same way.

EXAMPLE

Place these nine definitions in sets so that each set contains definitions that are similar.

bird - sings
dog - bone
giraffe - has a long neck
fire - burn
teacher - chalk
bunk - it has two levels
wolf - howls
elephant - has a trunk
blade - cut

There are many different correct ways of answering this question. The important things to remember are:

(a) You must have a reason for placing definitions in the same set.

(b) Look at the whole definition in deciding similarity.

(c) Definitions are similar if they define words in the same way.

DEMONSTRATION TWO

(A)

SET 1	SET 2	SET 3
bird - sings	dog - bone	bunk - it has two levels
wolf - howls	teacher - chalk	giraffe - has a long neck
fire - burn		elephant - has a trunk
blade - cut		

(B)

SET 1	SET 2
bird - sings	dog - bone
wolf - howls	bunk - it has two levels
fire - barn	giraffe - has a long neck
blade - cut	teacher - chalk
	elephant - has a trunk

For each example, try to give the rule that was used to place the definitions into each of the sets. You may see different ways of placing these definitions in sets. Your way would be correct for you.

Remember, we are concerned with similar definitions and not similar words. LOOK AT THE WHOLE DEFINITION.

INSTRUCTIONS FOR WORD DEFINITION SURVEY

You have been given a deck of 30 (24) cards and an answer sheet. On each card there is a definition. The word on the left is being defined by the word or words on the right. Place the cards in sets so that all cards in a set have definitions that are similar. YOU MAY USE AS MANY SETS AS YOU THINK NECESSARY.

Read the definitions and place them in sets as quickly as possible. Review your sets and rearrange them if necessary. Review again and again until you are satisfied that each set contains definitions that are similar.

Take one of your sets and call it set one. On the back of each definition there is a number. Place a "1" in the blank beside this number on the answer sheet. Therefore, you will indicate which definitions were placed in set one by placing a "1" in the blank beside their number on the answer sheet. Take another of your sets and call it set two. Place a "2" in the blank(s). Repeat until finished.

Please answer the questions on the answer sheet. When you are finished, hand cards and answer sheet to instructor.

THANK YOU

ANSWER SHEET

[Check one or more answer(s) for question (2)].

(1) I am in grade ( ) five ( ) eight ( ) eleven.

(2) I found this survey ( ) fun ( ) easy ( ) hard ( ) confusing ( ) way too hard, so I mostly guessed.

(3) In doing this survey ( ) I did my best
( ) I just put anything down.

(4) The edge of the deck of cards that I had was ( ) yellow ( ) red ( ) black ( ) brown ( ) green.

(5) I sorted my deck of cards into ____ sets. In my largest set I placed ____ cards and in the smallest set I placed ____ cards.

(6) Pick any one of your sets and explain how you decided that the definitions of that set were similar. Give the rule that you used to determine what definitions to include in that set.

____

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APPENDIX C

The Joint Proportion Matrices, the Latent Partition Matrices and the Confusion Matrices for the Fifteen Grade by Set Combinations

The Joint Proportion Matrix for Grade Five, Set A

Stimulus	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	100														
2	6	100													
3	17	9	100												
4	0	9	31	100											
5	63	0	11	0	100										
6	14	3	3	0	34	100									
7	37	3	14	23	31	0	100								
8	3	17	14	20	9	0	20	100							
9	9	63	6	9	3	3	3	14	100						
10	20	0	20	54	17	0	49	17	0	100					
11	34	9	14	3	31	20	6	6	9	3	100				
12	26	11	9	3	23	17	6	14	14	3	23	100			
13	3	43	26	11	9	9	6	14	40	3	9	11	100		
14	17	0	6	0	31	54	0	6	3	0	14	34	3	100	
15	17	3	3	0	37	74	3	6	3	0	14	20	0	66	100
16	26	6	20	26	20	0	54	29	6	49	6	0	6	3	0
17	3	0	26	83	3	0	29	17	0	60	0	0	9	0	0
18	6	9	29	63	0	0	17	29	6	46	0	3	11	3	0
19	14	3	29	3	20	23	6	14	6	3	20	37	14	37	20
20	3	57	17	14	0	3	6	6	49	6	6	6	37	0	0
21	11	17	11	9	17	31	3	11	20	3	11	29	9	26	20
22	20	9	11	11	17	9	14	9	11	17	46	11	11	14	6
23	26	3	11	0	29	23	0	6	9	0	63	29	6	34	23
24	23	3	20	31	23	0	71	20	3	57	6	3	3	0	0
25	3	57	9	11	0	3	6	40	54	3	3	9	43	3	0
26	6	14	17	31	6	0	23	29	17	34	3	0	9	0	3
27	3	3	26	83	3	0	26	17	3	60	0	0	6	0	0
28	17	6	14	0	26	37	3	14	3	0	14	37	14	49	37
29	3	51	11	11	3	3	6	17	51	0	11	9	49	6	6
30	14	3	17	26	17	0	49	34	3	43	6	3	9	3	3

Stimulus	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
16	100														
17	23	100													
18	34	66	100												
19	11	6	11	100											
20	29	6	14	6	100										
21	6	6	11	29	14	100									
22	26	6	20	20	9	20	100								
23	9	0	9	29	6	23	54	100							
24	77	31	26	9	20	6	17	0	100						
25	9	3	9	9	49	20	9	3	6	100					
26	60	29	40	9	46	9	20	3	51	17	100				
27	26	89	66	3	9	9	6	0	37	6	31	100			
28	3	0	3	43	0	23	11	23	0	3	3	0	100		
29	9	3	6	17	40	6	14	11	3	51	14	3	11	100	
30	83	23	34	11	29	3	26	3	74	6	71	26	3	9	100

(The entries in this matrix were multiplied by 100.)

The Transpose of Latent Partition Matrix for Grade Five, Set A

Stimulus	$1 - \Delta_j^2$	Latent Categories							
13	36	80	-6	7	-11	31	-9	7	-3
29	45	93	3	1	-5	13	-4	-1	2
20	61	99	2	-24	6	-1	45	-4	-23
25	62	101	-6	4	1	-10	-11	-2	28
9	57	109	3	8	2	-10	-8	-1	-2
2	64	118	-3	7	3	-12	-8	0	-1
22	45	3	84	-6	-8	-2	24	2	0
11	56	4	93	24	-4	-13	-10	-1	0
23	75	-6	110	-6	4	6	-2	0	1
7	60	-1	-22	89	-10	-7	31	8	5
5	55	0	10	93	24	1	-11	-7	1
1	54	7	16	104	-4	3	-14	-6	-5
14	59	-8	2	-5	63	53	2	-1	-1
6	63	5	2	1	88	0	0	3	-5
15	86	1	-3	3	110	-18	2	2	3
21	19	19	11	-3	16	42	-2	7	2
3	22	12	2	9	-20	57	5	29	-5
12	31	6	6	21	-4	78	-15	-3	5
28	45	-5	-10	5	19	97	-5	-4	4
19	55	-6	1	-7	-16	136	7	-3	-2
24	79	-5	-17	49	-6	0	79	6	-5
26	61	18	9	-37	10	-2	90	8	1
16	81	-4	2	17	-3	2	98	-8	2
30	88	-10	3	-8	3	5	112	-12	8
10	57	-9	-7	41	-3	-11	24	61	-1
18	56	-2	14	-25	-2	11	18	77	9
4	79	10	3	-8	2	-3	-4	107	0
27	88	-2	-3	1	4	-6	-5	114	-2
17	89	-6	-4	4	1	0	-12	117	-1
8	88	-1	1	-1	0	0	3	0	96

The Confusion Matrix for Grade Five, Set A

$$\begin{bmatrix} 50 & 8 & 3 & 2 & 9 & 11 & 6 & 18 \\ 8 & 60 & 18 & 20 & 21 & 6 & 2 & 6 \\ 3 & 18 & 50 & 16 & 13 & 26 & 12 & 10 \\ 2 & 20 & 16 & 80 & 28 & -3 & -2 & 4 \\ 9 & 21 & 13 & 28 & 37 & 5 & 5 & 14 \\ 11 & 6 & 26 & -3 & 5 & 77 & 32 & 26 \\ 6 & 2 & 12 & -2 & 5 & 32 & 71 & 19 \\ 18 & 6 & 10 & 4 & 14 & 26 & 19 & 93 \end{bmatrix}$$

(Entries for $1 - \Delta_j^2$, Φ' and Ω were multiplied by 100.)

The Joint Proportion Matrix for Grade Eight, Set A

Stimulus	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	100														
2	0	100													
3	40	8	100												
4	0	15	13	100											
5	60	0	38	0	100										
6	35	3	15	0	45	100									
7	23	10	8	55	25	5	100								
8	8	25	23	20	13	8	18	100							
9	3	88	10	15	3	5	10	25	100						
10	13	10	8	70	13	5	70	13	10	100					
11	50	3	25	3	53	48	8	15	3	8	100				
12	50	5	43	5	45	43	13	15	5	8	68	100			
13	0	80	10	13	0	3	8	15	70	13	0	0	100		
14	48	0	28	3	40	73	5	8	3	8	55	60	3	100	
15	35	3	20	0	50	80	5	5	5	5	48	45	3	78	100
16	18	13	13	33	15	8	53	45	13	48	10	10	13	10	5
17	3	13	10	85	3	3	50	10	15	78	0	3	15	8	5
18	8	8	20	45	5	5	30	33	10	40	3	8	13	10	5
19	45	8	38	3	45	45	5	10	3	10	53	65	10	65	53
20	0	73	3	13	0	3	8	15	68	13	3	3	78	0	3
21	53	3	38	3	38	38	10	13	5	10	50	60	8	53	40
22	35	5	35	10	28	25	20	38	3	23	45	40	5	33	25
23	48	0	25	0	58	65	8	5	3	8	75	50	0	58	63
24	18	15	5	58	18	5	70	13	13	80	3	8	18	8	8
25	0	78	5	13	0	5	8	28	78	13	3	3	75	0	3
26	5	8	13	28	3	5	28	45	8	33	8	8	13	10	5
27	0	13	10	83	3	0	58	18	13	73	5	8	13	5	3
28	58	0	33	0	40	60	5	8	3	5	55	68	3	78	63
29	3	73	5	13	0	5	10	15	65	15	5	5	70	0	3
30	13	10	15	30	10	5	35	53	10	33	10	13	10	10	8

Stimulus	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
16	100														
17	35	100													
18	60	55	100												
19	8	5	10	100											
20	15	15	10	8	100										
21	10	5	13	58	3	100									
22	45	13	38	33	5	28	100								
23	5	3	3	58	0	43	38	100							
24	53	65	33	13	20	8	23	8	100						
25	15	15	10	8	78	3	5	3	18	100					
26	68	33	68	8	23	15	35	3	28	10	100				
27	35	83	48	3	13	5	18	0	60	13	30	100			
28	5	3	8	65	0	65	35	55	5	0	5	0	100		
29	15	18	10	8	75	3	5	0	20	78	10	15	0	100	
30	70	25	58	8	18	8	43	5	33	10	83	35	5	8	100

(The entries in this matrix were multiplied by 100.)

The Transpose of Latent Partition Matrix for Grade Eight, Set A

Stimulus	$1 - \Delta_j^2$	Latent Categories					
27	78	78	15	6	-3	2	-1
4	78	83	8	9	-5	-3	0
17	90	92	4	1	6	-4	1
5	52	-34	66	59	13	-10	-3
10	81	44	75	-8	2	-5	-2
24	73	18	98	-18	4	-4	7
7	67	4	106	-7	-7	2	-3
22	43	-12	15	62	-7	51	-4
11	57	-13	17	87	14	-3	0
28	71	13	-22	94	30	-6	-3
19	59	9	-11	99	13	-6	6
1	57	-26	50	100	-14	-9	-3
3	33	8	-11	106	-35	9	4
21	53	10	-14	114	-9	-2	0
12	68	7	-9	129	-11	-5	0
23	62	-16	28	47	48	-9	-2
14	78	16	-24	47	69	5	-4
15	81	1	-1	-9	101	2	1
6	78	-4	4	-19	104	4	2
8	36	-9	-5	25	-12	67	18
18	61	40	-26	13	-2	77	-5
16	75	-18	55	-14	1	86	1
30	79	-9	8	-6	3	110	-3
26	80	7	-20	-8	7	113	-2
29	68	0	7	-2	2	-5	94
20	73	-2	0	-9	6	8	97
9	72	1	-2	5	-1	-2	98
13	74	4	-6	5	-1	-1	98
25	81	-3	2	-4	3	1	103
2	84	-1	-1	6	-4	-3	106

The Confusion Matrix for Grade Eight, Set A

$$\begin{bmatrix} 104 & 51 & 1 & -2 & 34 & 16 \\ 51 & 59 & 15 & 13 & 29 & 10 \\ 1 & 15 & 50 & 47 & 11 & 3 \\ -2 & 13 & 47 & 87 & 4 & 2 \\ 34 & 29 & 11 & 4 & 68 & 13 \\ 16 & 10 & 3 & 2 & 13 & 76 \end{bmatrix}$$

(Entries for $1 - \Delta_j^2$, Φ' and Ω were multiplied by 100.)

The Joint Proportion Matrix for Grade Eleven, Set A

Stimulus	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	100														
2	0	100													
3	35	5	100												
4	3	15	15	100											
5	65	0	23	3	100										
6	30	0	23	3	58	100									
7	28	18	8	50	20	3	100								
8	8	33	20	18	0	0	30	100							
9	0	90	8	18	0	0	15	28	100						
10	15	15	8	75	10	3	73	18	13	100					
11	40	0	23	3	60	63	3	3	3	3	100				
12	58	3	45	0	38	35	0	8	3	0	50	100			
13	3	63	15	23	3	3	23	13	63	20	0	8	100		
14	55	0	38	0	43	63	0	5	0	0	58	68	3	100	
15	30	0	18	3	55	85	3	0	0	3	60	35	3	60	100
16	25	5	20	25	15	0	48	50	3	48	3	5	5	5	0
17	0	18	15	95	0	3	50	20	18	75	3	0	20	0	3
18	5	8	25	50	0	0	20	53	5	40	3	8	5	5	0
19	40	0	28	3	60	68	3	0	0	3	68	63	5	50	63
20	0	65	8	20	0	0	18	15	68	18	0	3	73	0	0
21	48	3	48	3	38	28	0	8	3	0	43	70	5	58	25
22	23	13	25	13	18	10	30	50	13	20	28	18	8	20	10
23	35	3	20	3	65	73	5	3	5	3	83	35	3	48	70
24	25	13	8	58	18	3	85	18	10	80	5	3	18	3	3
25	0	83	8	20	0	0	18	33	88	15	0	3	68	0	0
26	5	10	25	30	0	0	23	55	8	28	3	5	5	5	0
27	5	18	15	95	5	3	55	20	18	80	3	0	23	0	3
28	48	3	45	5	38	53	3	5	3	5	53	70	5	78	48
29	0	73	10	18	0	0	15	23	80	13	0	5	73	0	0
30	20	8	20	28	10	0	45	48	5	48	3	5	8	5	0

Stimulus	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
16	100														
17	25	100													
18	63	55	100												
19	0	5	8	100											
20	10	20	8	0	100										
21	3	3	5	43	5	100									
22	53	15	45	10	10	20	100								
23	0	3	0	65	3	28	25	100							
24	55	58	23	5	15	3	28	3	100						
25	3	20	5	0	73	5	13	3	13	100					
26	73	33	70	0	30	5	48	0	30	8	100				
27	30	95	50	3	20	3	18	3	63	20	30	100			
28	5	5	5	58	3	60	13	43	3	3	5	5	100		
29	5	18	8	3	78	8	13	3	10	80	13	18	3	100	
30	90	28	60	0	18	3	48	0	53	5	78	33	5	8	100

(The entries in this matrix were multiplied by 100.)

The Transpose of Latent Partition Matrix for Grade Eleven, Set A

Stimulus	$1 - \Delta_j^2$	Latent Categories					
5	59	70	16	-5	-20	-2	40
19	64	72	35	-5	5	-1	-3
11	68	86	18	3	-1	-1	-1
15	71	108	-12	-1	5	0	-6
6	77	111	-10	-1	6	0	-8
23	79	116	-19	3	-2	4	0
1	58	3	78	-2	-26	-5	52
3	36	-14	78	25	11	4	-13
14	68	31	83	1	1	-3	-5
28	68	15	97	-4	9	-1	-8
21	62	-21	116	-4	2	2	-3
12	78	-13	124	-4	0	1	-3
22	41	14	10	73	-12	7	7
8	45	-1	2	82	-4	24	-11
18	78	2	4	97	45	-9	-41
30	82	-3	-5	101	-15	-5	32
16	89	-4	-5	103	-22	-9	40
26	77	1	-3	114	7	2	-21
27	94	1	1	-2	88	1	15
4	93	1	2	-4	94	1	5
17	97	3	1	1	97	0	-1
13	59	-4	9	-12	5	86	11
20	65	0	-1	7	1	91	1
2	77	2	-4	2	-3	101	1
29	79	-2	4	0	0	102	-3
9	84	4	-3	-2	-1	106	-2
25	86	0	0	-3	1	107	0
10	82	-2	-6	0	46	-3	64
7	77	-3	-7	1	2	7	97
24	88	-5	-4	1	10	-3	100

The Confusion Matrix for Grade Eleven, Set A

$$\begin{bmatrix} 70 & 41 & 3 & 0 & 0 & 9 \\ 41 & 59 & 9 & 1 & 3 & 9 \\ 3 & 9 & 66 & 31 & 11 & 32 \\ 0 & 1 & 31 & 103 & 19 & 49 \\ 0 & 3 & 11 & 19 & 76 & 13 \\ 9 & 9 & 32 & 49 & 13 & 78 \end{bmatrix}$$

(Entries for $1 - \Delta_j^2$, Φ' and Ω were multiplied by 100.)

The Joint Proportion Matrix for Grade Five, Set B

Stimulus	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	100														
2	44	100													
3	18	15	100												
4	32	15	77	100											
5	12	0	15	15	100										
6	9	6	50	59	24	100									
7	21	12	12	15	18	12	100								
8	21	12	35	24	18	9	21	100							
9	15	12	6	6	12	6	35	15	100						
10	6	6	29	29	24	47	6	12	15	100					
11	47	24	35	35	9	24	12	9	3	15	100				
12	12	3	15	9	21	6	24	35	18	15	12	100			
13	24	12	32	32	21	35	12	18	9	38	29	18	100		
14	21	41	6	12	6	15	18	6	18	15	9	24	15	100	
15	12	0	12	9	35	9	32	15	27	21	9	29	18	24	100
16	3	6	29	38	24	65	24	9	24	35	21	18	35	18	18
17	9	3	12	12	21	21	32	38	15	24	9	29	32	18	24
18	12	18	9	12	15	18	24	35	15	12	12	27	21	38	29
19	21	47	3	6	9	6	18	9	6	12	9	15	9	47	9
20	12	6	3	6	21	6	24	12	41	15	6	21	9	12	32
21	21	47	3	6	12	3	18	6	12	3	6	12	6	44	6
22	18	44	12	6	12	9	9	9	12	12	3	24	3	53	15
23	6	0	15	12	24	12	47	9	47	6	9	29	12	12	35
24	15	6	27	24	18	27	15	9	12	38	15	15	44	12	18
25	9	15	32	27	12	32	9	12	12	35	15	15	35	12	6
26	50	27	35	35	6	24	6	6	3	12	91	6	24	9	3
27	15	12	50	35	32	32	12	21	6	35	18	21	29	15	15
28	32	82	12	15	3	12	12	3	9	9	18	3	15	53	9
29	44	18	29	32	6	18	9	6	9	29	68	9	35	9	9
30	12	6	9	9	24	9	41	29	27	6	12	35	12	9	29

Stimulus	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
16	100														
17	24	100													
18	21	35	100												
19	6	35	18	100											
20	6	21	21	12	100										
21	0	18	12	71	18	100									
22	3	12	21	56	12	62	100								
23	29	15	9	3	29	9	12	100							
24	15	24	9	29	12	27	18	15	100						
25	15	18	12	21	15	21	18	15	65	100					
26	15	3	6	9	9	12	9	6	18	18	100				
27	24	18	12	15	6	12	24	18	38	44	18	100			
28	12	9	21	47	9	50	50	6	12	18	24	15	100		
29	9	6	12	6	15	9	6	6	27	27	71	32	24	100	
30	24	21	27	15	35	18	9	29	12	12	9	12	3	12	100

(The entries in this matrix were multiplied by 100.)

The Transpose of Latent Partition Matrix for Grade Five, Set B

Stimulus	$1 - \Delta_j^2$	Latent Categories							
5	20	31	-14	18	7	27	1	16	-1
15	32	62	1	10	-8	41	-12	10	-1
30	35	64	-19	-3	13	50	-2	-11	11
20	29	75	2	-10	-2	15	-11	17	5
7	39	83	-4	6	10	26	1	-15	5
9	40	106	21	-1	-16	-11	-5	7	-7
23	57	134	-6	6	1	-35	9	0	-4
14	47	2	46	29	32	24	-14	-9	-6
2	78	-1	105	-12	1	5	7	-9	0
28	83	2	110	7	1	-9	-4	3	-7
6	76	-17	-4	106	4	-16	17	4	1
16	65	22	0	110	-4	-6	-4	-20	2
22	53	8	24	-2	67	-2	8	3	-10
19	73	-22	-4	7	98	15	-8	8	7
21	73	12	1	-9	99	-20	4	6	6
12	31	30	-16	-7	13	75	1	3	2
17	43	-18	-22	23	21	102	-17	14	2
18	39	-11	22	21	-8	107	-18	-9	-1
8	58	-15	-1	-33	-9	144	29	-13	-10
4	66	0	6	32	-1	3	59	-8	11
3	88	4	0	1	0	13	84	4	-2
27	40	6	2	-2	3	11	29	61	-7
13	43	-19	14	29	-25	42	-11	64	14
10	41	-12	8	45	-16	13	-8	68	-5
25	56	5	6	-12	1	-13	9	113	-10
24	66	3	-14	-11	16	-11	-4	126	-1
1	41	12	37	-23	-7	27	7	-3	48
29	64	2	16	-14	-22	1	-6	47	76
11	88	-5	-9	10	4	5	-2	-13	111
26	93	-1	-5	-1	10	-17	4	-6	112

The Confusion Matrix for Grade Five, Set B

$$\begin{bmatrix} 38 & 7 & 15 & 13 & 19 & 6 & 12 & 8 \\ 7 & 70 & 11 & 45 & 11 & 14 & 12 & 24 \\ 15 & 11 & 59 & 7 & 17 & 39 & 26 & 17 \\ 13 & 45 & 7 & 74 & 16 & 0 & 16 & 5 \\ 19 & 11 & 17 & 16 & 32 & 16 & 15 & 11 \\ 6 & 14 & 39 & 0 & 16 & 116 & 32 & 37 \\ 12 & 12 & 26 & 16 & 15 & 32 & 47 & 20 \\ 8 & 24 & 17 & 5 & 11 & 37 & 20 & 77 \end{bmatrix}$$

(Entries for $1 - \Delta_j^2$, Φ' and Ω were multiplied by 100.)

The Joint Proportion Matrix for Grade Eight, Set B

Stimulus	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	100														
2	40	100													
3	34	8	100												
4	34	13	79	100											
5	8	8	3	5	100										
6	32	18	50	66	8	100									
7	13	8	13	11	37	16	100								
8	21	5	13	11	34	16	32	100							
9	13	11	16	13	29	21	63	34	100						
10	18	8	61	63	8	53	11	3	16	100					
11	34	11	47	50	8	42	11	8	11	32	100				
12	26	16	16	8	29	11	29	40	29	21	11	100			
13	24	5	53	50	3	45	13	11	18	63	40	16	100		
14	29	82	8	8	5	16	8	8	16	11	5	18	8	100	
15	16	8	8	5	29	13	58	34	45	3	8	29	11	11	100
16	24	3	47	47	8	55	29	18	26	47	40	13	47	5	18
17	21	8	16	8	26	13	34	58	34	13	5	34	13	11	34
18	21	11	16	11	32	18	32	45	34	8	13	42	18	13	40
19	29	79	11	8	8	11	13	11	13	11	8	18	5	84	11
20	13	8	16	11	40	13	34	32	58	13	8	29	11	16	42
21	32	82	8	11	11	13	11	11	11	8	11	18	5	82	11
22	32	84	11	11	5	13	11	13	16	13	5	18	8	87	11
23	11	8	13	8	32	11	63	24	50	5	13	21	11	11	58
24	21	5	58	55	3	50	13	5	18	74	37	16	76	8	8
25	24	3	66	61	0	50	13	11	16	76	40	13	74	5	5
26	32	13	50	50	3	42	13	8	13	40	90	11	42	13	8
27	24	11	63	58	16	42	3	13	8	66	34	18	58	11	8
28	40	92	13	13	3	18	8	3	8	13	11	13	8	84	5
29	32	11	53	53	13	45	16	8	21	53	66	11	53	5	11
30	16	16	8	11	42	16	47	24	47	13	8	37	8	13	42

Stimulus	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
16	100														
17	24	100													
18	26	34	100												
19	5	11	11	100											
20	13	24	40	13	100										
21	3	11	11	97	11	100									
22	5	13	13	84	18	82	100								
23	26	29	42	8	37	5	8	100							
24	45	8	8	8	13	5	11	11	100						
25	50	11	13	5	11	3	8	11	84	100					
26	42	5	11	16	8	13	13	13	42	42	100				
27	37	11	16	11	16	11	13	8	63	66	37	100			
28	8	11	8	82	8	79	87	5	11	8	18	13	100		
29	37	13	16	8	16	11	8	11	53	53	66	42	11	100	
30	11	37	37	13	55	16	16	40	8	5	3	11	11	16	100

(The entries in this matrix were multiplied by 100.)

The Transpose of Latent Partition Matrix for Grade Eight, Set B

Stimulus	$1 - \Delta_j^2$	Latent Categories					
16	49	55	54	-48	12	28	-4
6	46	62	17	-21	19	17	8
4	62	78	-3	-11	27	10	2
3	62	82	-3	-9	20	18	0
27	59	99	-34	26	-4	10	2
13	61	100	8	-6	-3	0	-3
10	74	121	-13	18	-14	-14	2
24	77	122	7	4	-14	-22	-1
25	82	125	7	-11	-14	-4	-4
9	55	10	69	39	-3	-7	2
15	49	-9	75	14	-1	16	0
23	58	-6	104	2	2	-8	-1
7	70	-2	116	-2	-3	-6	1
5	33	-7	-6	69	6	22	-5
30	54	2	12	92	2	-5	2
20	54	10	3	100	2	-10	-1
29	59	41	-7	24	62	-12	-4
26	81	-1	8	-8	103	-7	4
11	94	-17	-5	5	122	-3	-5
1	32	8	-7	-8	30	44	32
12	34	10	-17	41	-3	61	8
18	40	-1	14	25	4	63	-1
17	45	2	13	-6	-10	98	1
8	66	-9	-9	-6	-4	137	-5
21	84	-7	-7	7	4	1	101
14	83	3	5	1	-7	-5	102
2	84	-6	-1	-1	5	-3	102
22	86	6	-2	5	-9	1	102
19	86	-2	2	2	-2	-3	103
28	87	2	5	-13	1	-3	105

The Confusion Matrix for Grade Eight, Set B

$$\begin{bmatrix} 62 & 14 & 8 & 42 & 14 & 10 \\ 14 & 58 & 39 & 14 & 29 & 9 \\ 8 & 39 & 55 & 5 & 30 & 13 \\ 42 & 14 & 5 & 76 & 13 & 13 \\ 14 & 29 & 30 & 13 & 44 & 11 \\ 10 & 9 & 13 & 13 & 11 & 81 \end{bmatrix}$$

(Entries for $1 - \Delta_j^2$, Φ' and Ω were multiplied by 100.)

The Joint Proportion Matrix for Grade Eleven, Set B

Stimulus	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	100														
2	31	100													
3	39	10	100												
4	39	10	90	100											
5	21	0	10	8	100										
6	31	13	74	82	13	100									
7	23	5	8	8	41	13	100								
8	18	8	10	10	46	13	36	100							
9	28	3	8	8	44	15	64	39	100						
10	26	8	69	64	8	62	8	8	5	100					
11	31	10	54	54	8	49	8	5	8	39	100				
12	21	3	8	8	39	13	49	41	39	13	8	100			
13	28	10	59	54	8	49	10	8	8	64	41	10	100		
14	28	92	10	10	0	15	3	8	0	10	10	5	10	100	
15	18	5	8	8	44	15	72	33	64	5	8	54	8	5	100
16	23	5	67	72	8	74	15	10	13	72	44	13	54	3	10
17	13	8	5	5	41	10	36	85	44	10	5	36	8	8	36
18	33	3	10	10	46	15	51	36	62	5	8	54	10	5	56
19	26	87	10	10	0	13	0	10	0	10	10	5	10	87	5
20	26	3	5	5	44	10	51	28	54	5	5	59	8	3	56
21	26	90	10	10	0	13	0	8	0	8	10	3	10	90	5
22	26	90	10	10	0	15	0	8	0	8	10	3	10	95	5
23	18	8	8	8	39	10	64	28	67	8	5	49	8	5	69
24	26	5	54	49	8	49	10	10	8	67	39	10	85	5	8
25	26	5	69	62	10	62	10	10	8	82	39	10	74	5	8
26	31	10	54	54	8	49	8	5	8	39	100	8	41	10	8
27	28	8	72	62	13	59	13	13	8	74	39	13	67	8	13
28	33	92	15	15	3	18	5	5	3	13	13	5	15	87	10
29	31	3	59	59	10	49	10	5	10	59	59	10	67	3	10
30	21	3	8	8	44	15	59	28	51	8	5	54	10	3	56

Stimulus	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
16	100														
17	15	100													
18	8	36	100												
19	3	10	3	100											
20	10	26	54	3	100										
21	3	8	3	92	5	100									
22	3	8	5	90	5	95	100								
23	21	31	49	5	59	5	5	100							
24	49	8	8	8	8	8	5	8	100						
25	62	8	8	5	8	8	5	8	85	100					
26	44	5	8	10	5	10	10	5	39	39	100				
27	62	10	10	8	13	8	8	8	64	80	39	100			
28	8	5	5	85	8	85	85	8	8	10	13	15	100		
29	46	8	10	3	8	3	3	10	69	67	59	62	8	100	
30	10	31	44	3	54	5	3	46	13	13	5	13	5	10	100

(The entries in this matrix were multiplied by 100.)

The Transpose of Latent Partition Matrix for Grade Eleven, Set B

Stimulus	$1 - \Delta_j^2$	Latent Categories					
1	28	35	25	3	15	22	0
5	37	60	-5	1	3	-1	28
12	46	85	0	7	-1	-4	11
18	51	94	0	-4	3	2	7
30	48	97	0	10	-4	-5	-3
9	61	104	-4	-7	2	3	6
20	55	108	1	3	-2	-5	-9
7	63	111	-2	2	-1	-2	-2
23	60	114	2	-4	-4	5	-11
15	69	119	2	-3	0	-1	-7
28	84	8	97	1	-1	6	-6
19	87	-5	99	2	0	-4	6
14	92	-1	102	-2	-1	1	1
2	92	1	102	-2	0	1	-1
21	91	-2	102	4	0	-5	1
22	93	-2	103	-2	0	0	1
10	73	-7	0	59	-14	55	2
27	69	2	0	63	-10	44	2
29	65	5	-6	73	32	-3	-4
25	88	-3	-2	98	-13	23	0
13	74	1	5	104	4	-9	-2
24	88	-1	0	129	1	-30	0
11	99	-1	0	-1	100	2	0
26	99	-1	0	-1	100	2	0
16	66	5	-7	5	-6	93	2
3	82	-5	0	3	5	100	-1
6	74	6	4	-14	1	108	1
4	88	-5	-1	-21	6	120	-1
17	73	7	1	1	0	-2	92
8	99	-8	0	-1	0	1	113

The Confusion Matrix for Grade Eleven, Set B

$$\begin{bmatrix} 53 & 4 & 10 & 8 & 11 & 33 \\ 4 & 88 & 8 & 11 & 11 & 7 \\ 10 & 8 & 75 & 40 & 57 & 9 \\ 8 & 11 & 40 & 98 & 48 & 5 \\ 11 & 11 & 57 & 48 & 75 & 10 \\ 33 & 7 & 9 & 5 & 10 & 82 \end{bmatrix}$$

(Entries for $1 - \Delta_j^2$, Φ' and Ω were multiplied by 100.)

The Joint Proportion Matrix for Grade Five, Set C

Stimulus	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	100																							
2	63	100																						
3	14	14	100																					
4	6	9	14	100																				
5	3	3	6	23	100																			
6	9	3	9	6	43	100																		
7	11	6	6	3	37	60	100																	
8	9	6	6	9	46	71	77	100																
9	31	3	11	3	17	43	66	54	100															
10	46	54	17	11	3	6	6	3	3	100														
11	11	3	3	6	34	63	94	74	69	6	100													
12	20	11	63	17	9	11	6	14	14	11	3	100												
13	6	6	11	34	40	6	6	9	9	9	6	20	100											
14	0	0	9	26	34	9	11	6	14	6	9	9	60	100										
15	11	6	6	3	37	60	100	77	66	6	94	6	6	11	100									
16	0	6	9	17	57	23	29	26	9	0	26	3	34	31	29	100								
17	23	17	63	17	6	6	6	9	14	20	6	71	14	3	6	3	100							
18	49	63	11	11	11	3	6	9	3	80	3	11	9	3	6	3	14	100						
19	49	66	11	14	3	6	3	6	3	66	6	11	14	3	3	0	20	71	100					
20	0	3	9	23	54	23	17	17	6	3	20	0	37	34	17	86	3	3	3	100				
21	9	9	57	14	9	17	6	9	11	11	9	63	17	11	6	3	60	9	9	3	100			
22	51	66	17	9	0	6	0	0	6	63	0	11	6	9	0	0	14	71	74	0	9	100		
23	6	3	46	14	6	6	3	6	9	11	6	51	14	31	3	0	49	9	6	0	63	9	100	
24	6	3	46	11	9	9	3	6	6	11	3	49	11	29	3	3	51	9	6	3	57	9	94	100

(The entries in this matrix were multiplied by 100.)

The Transpose of Latent Partition Matrix for Grade Five, Set C

Stimulus	$1 - \Delta_j^2$	Latent Categories				
1	43	77	20	-14	-8	13
2	61	99	12	-16	2	-1
10	62	101	-3	8	-3	0
19	71	109	-1	-2	1	-2
22	70	109	-5	5	-4	-4
18	75	113	-9	6	1	0
21	60	-6	71	32	0	2
3	56	1	90	1	9	-4
12	70	-4	100	3	5	-1
17	71	4	103	-2	2	-2
14	47	8	-44	70	63	-4
24	79	-1	12	102	-12	1
23	95	-1	4	119	-18	3
4	15	13	6	15	43	-8
13	38	11	-10	31	76	-12
5	53	0	-3	4	86	25
16	71	-5	10	-19	117	3
20	74	-3	7	-17	123	-8
6	47	-1	9	-3	15	72
9	48	3	8	5	-13	78
8	69	-2	8	-5	9	91
11	91	-1	-7	4	-3	109
7	95	0	-5	1	-2	111
15	95	0	-5	1	-2	111

The Confusion Matrix for Grade Five, Set C

$$\begin{bmatrix} 61 & 14 & 6 & 4 & 5 \\ 14 & 68 & 42 & 5 & 8 \\ 6 & 42 & 67 & 11 & 5 \\ 4 & 5 & 11 & 53 & 19 \\ 5 & 8 & 5 & 19 & 79 \end{bmatrix}$$

(Entries for $1 - \Delta_j^2$, Φ' and Ω were multiplied by 100.)

The Joint Proportion Matrix for Grade Eight, Set C

Stimulus	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	100																							
2	83	100																						
3	10	10	100																					
4	5	5	7	100																				
5	10	10	2	46	100																			
6	2	2	2	7	49	100																		
7	10	2	0	5	37	83	100																	
8	2	2	2	10	51	98	81	100																
9	22	5	5	5	22	68	85	66	100															
10	71	78	10	17	7	0	0	0	5	100														
11	7	2	0	5	39	85	98	83	83	0	100													
12	7	7	90	10	0	2	0	2	5	7	0	100												
13	10	10	7	83	37	12	12	15	12	17	12	10	100											
14	7	7	5	71	37	15	15	17	15	7	15	7	83	100										
15	10	5	0	5	34	81	93	78	78	2	95	0	12	15	100									
16	10	10	2	46	76	29	24	32	10	7	27	0	37	42	29	100								
17	5	2	90	12	0	2	0	2	5	10	0	90	7	5	0	0	100							
18	73	85	5	15	12	2	2	5	5	88	2	5	15	10	5	12	7	100						
19	83	95	12	7	10	2	2	2	7	83	2	10	12	7	5	10	5	85	100					
20	7	7	0	51	71	27	22	29	7	7	24	2	39	42	27	95	2	12	7	100				
21	2	0	83	7	0	7	5	5	10	5	5	83	10	12	5	0	81	0	0	0	100			
22	71	88	2	15	7	0	0	0	2	76	0	10	15	5	2	7	5	81	83	12	0	100		
23	2	0	68	2	0	7	7	5	12	2	7	66	5	17	7	0	68	0	0	0	73	0	100	
24	2	0	71	5	0	2	2	0	7	2	2	71	2	15	2	0	73	0	0	2	73	2	95	100

(The entries in this matrix were multiplied by 100.)

The Transpose of Latent Partition Matrix for Grade Eight, Set C

Stimulus	$1 - \Delta_j^2$	Latent Categories				
8	79	92	-3	15	-4	0
6	83	96	-3	12	-6	2
9	72	96	6	-24	11	4
15	86	102	2	1	-2	-1
7	95	108	-1	-6	2	-2
11	97	109	-1	-2	-1	-2
1	70	8	91	-3	-2	1
10	76	-3	95	-4	8	2
22	77	-4	96	1	2	-1
18	84	-1	100	3	2	-2
19	93	0	106	0	-3	1
2	93	0	106	2	-6	-1
5	65	21	1	74	7	-2
20	89	-6	0	102	1	1
16	96	-4	0	108	-6	1
4	76	-11	0	18	87	1
14	70	5	-4	2	92	4
13	98	3	2	-11	115	-3
23	68	7	-5	-4	3	93
24	73	0	-4	0	0	96
21	79	4	-4	-4	4	100
12	83	-3	4	2	0	103
17	84	-3	2	3	-2	104
3	85	-3	5	4	-5	104

The Confusion Matrix for Grade Eight, Set C

$$\begin{bmatrix} 83 & 4 & 27 & 12 & 3 \\ 4 & 83 & 9 & 11 & 4 \\ 27 & 9 & 88 & 42 & 1 \\ 12 & 11 & 42 & 81 & 8 \\ 3 & 4 & 1 & 8 & 79 \end{bmatrix}$$

(Entries for $1 - \Delta_j^2$, Φ' and Ω were multiplied by 100.)

The Joint Proportion Matrix for Grade Eleven, Set C

Stimulus	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	100																							
2	85	100																						
3	5	10	100																					
4	15	10	8	100																				
5	3	3	0	35	100																			
6	0	0	3	3	45	100																		
7	5	3	3	0	25	60	100																	
8	3	3	0	5	50	95	63	100																
9	18	5	3	8	15	55	85	55	100															
10	73	85	10	10	3	0	3	3	5	100														
11	5	3	3	0	25	60	100	63	85	3	100													
12	5	8	90	10	5	5	0	5	0	10	0	100												
13	10	8	5	78	33	5	5	3	10	8	5	8	100											
14	5	5	5	70	33	5	5	3	5	5	5	8	88	100										
15	5	3	3	0	25	60	100	63	85	3	100	0	5	5	100									
16	8	3	0	58	60	15	10	18	8	3	10	3	53	53	10	100								
17	5	5	93	5	0	3	3	0	3	10	3	90	3	3	3	3	100							
18	75	88	8	10	3	0	3	3	5	98	3	8	8	5	3	3	8	100						
19	80	95	13	8	0	3	3	0	5	85	3	5	8	5	3	0	8	88	100					
20	3	0	0	50	60	18	13	18	8	3	13	0	50	50	13	93	5	3	0	100				
21	3	5	90	8	3	3	0	3	0	5	0	88	5	5	0	3	88	3	5	5	100			
22	80	90	10	10	3	5	0	3	5	80	0	8	10	5	0	0	5	83	95	0	8	100		
23	8	5	80	10	0	0	3	0	5	8	3	78	5	13	3	5	83	5	5	5	85	3	100	
24	8	5	78	10	5	3	5	5	8	8	5	78	8	15	5	10	80	5	3	5	80	0	95	100

(The entries in this matrix were multiplied by 100.)

The Transpose of Latent Partition Matrix for Grade Eleven, Set C

Stimulus	$1 - \Delta_j^2$	Latent Categories				
24	78	95	4	-3	-2	8
23	83	98	4	-2	-8	7
12	85	100	-5	2	7	-3
3	88	102	1	4	-3	-2
21	88	102	-5	-2	5	-3
17	89	103	-1	1	1	-4
9	75	0	86	4	-4	9
7	98	-1	95	-2	5	4
11	98	-1	95	-2	5	4
15	98	-1	95	-2	5	4
1	70	-1	7	90	-6	7
10	82	3	-1	98	2	0
22	86	-1	-4	100	4	-2
18	87	0	-2	101	2	0
2	94	0	-1	104	0	0
19	94	0	0	105	-1	-1
16	73	-2	-23	-3	69	63
20	68	-2	-22	-4	70	58
6	73	2	23	1	99	-31
5	61	-2	-20	0	104	18
8	82	1	22	2	108	-35
4	65	2	0	5	0	90
14	73	2	10	-2	-14	100
13	80	-2	13	1	-19	106

The Confusion Matrix for Grade Eleven, Set C

$$\begin{bmatrix} 85 & 3 & 6 & 3 & 7 \\ 3 & 104 & 4 & 40 & -2 \\ 6 & 4 & 86 & 1 & 6 \\ 3 & 40 & 1 & 57 & 24 \\ 7 & -2 & 6 & 24 & 78 \end{bmatrix}$$

(Entries for $1 - \Delta_j^2$, Φ' and Ω were multiplied by 100.)

The Joint Proportion Matrix for Grade Five, Set D

Stimulus	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	100														
2	25	100													
3	56	25	100												
4	19	19	19	100											
5	58	19	39	8	100										
6	25	22	28	17	19	100									
7	8	8	8	14	8	11	100								
8	19	14	19	72	11	8	14	100							
9	28	58	25	11	19	31	8	14	100						
10	0	0	3	11	6	6	31	11	0	100					
11	28	33	19	14	22	28	6	14	31	0	100				
12	22	36	25	11	25	19	11	17	33	6	58	100			
13	17	25	8	22	8	17	8	17	25	3	31	28	100		
14	3	6	8	22	0	0	36	22	6	36	6	6	3	100	
15	8	6	8	11	6	11	39	17	11	47	6	3	3	28	100
16	19	25	33	8	17	33	17	14	33	3	19	42	11	6	8
17	19	25	22	11	11	22	17	11	19	8	14	25	44	11	8
18	8	8	11	25	3	3	11	36	8	14	6	8	3	28	14
19	14	11	8	25	3	3	25	31	8	11	8	8	11	33	25
20	14	11	14	25	14	8	33	31	22	17	14	14	22	19	33
21	14	11	19	36	6	3	8	44	8	11	14	6	6	25	11
22	19	42	22	14	19	42	14	17	39	3	44	50	25	6	6
23	6	3	8	8	6	0	31	17	8	61	3	6	3	28	36
24	3	11	8	25	14	14	31	19	6	22	11	14	14	31	31
25	14	11	17	53	14	14	14	53	8	19	6	8	19	25	17
26	11	17	17	53	6	8	14	44	11	8	11	11	17	17	11
27	8	11	11	22	8	6	31	19	11	22	11	11	14	31	31
28	3	6	6	14	3	0	28	11	8	53	8	8	6	31	22
29	8	11	14	44	6	14	14	50	3	19	22	11	22	17	11
30	8	19	8	8	6	14	39	8	19	8	14	11	6	31	17

Stimulus	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
16	100														
17	39	100													
18	8	6	100												
19	17	14	31	100											
20	14	8	25	36	100										
21	6	6	72	28	22	100									
22	36	28	8	6	11	3	100								
23	8	11	8	22	19	11	6	100							
24	8	3	17	19	22	17	11	17	100						
25	3	6	28	25	28	39	6	11	31	100					
26	14	8	36	31	28	33	14	8	19	44	100				
27	8	14	28	25	36	22	11	19	47	25	28	100			
28	8	8	14	17	25	17	8	81	17	8	11	28	100		
29	8	11	17	28	19	31	8	11	22	42	47	22	8	100	
30	17	11	6	17	22	6	17	14	25	14	19	25	17	11	100

(The entries in this matrix were multiplied by 100.)

The Transpose of Latent Partition Matrix for Grade Five, Set D

Stimulus	$1 - \Delta_j^2$	Latent Categories							
2	36	52	1	40	3	5	-5	1	3
22	51	76	-14	49	1	4	1	-6	-4
12	51	92	-3	14	-3	-4	5	3	3
11	56	117	5	-36	1	-2	2	8	3
3	45	-8	68	43	-9	14	2	-10	4
5	45	19	86	-20	15	-6	-1	-3	-7
1	78	-6	117	-1	-5	-1	0	5	2
6	25	23	12	48	13	15	-7	-6	-15
9	37	45	6	50	6	-6	-1	-1	4
17	45	-36	2	94	-4	-8	6	40	3
16	47	-3	-4	116	1	3	0	-13	1
19	27	-21	-2	22	54	19	0	4	21
20	30	-2	8	0	79	8	-1	11	11
14	34	-9	-8	4	87	1	11	-5	15
15	34	-11	8	0	99	-9	17	-3	-4
30	27	8	-10	26	102	-6	-14	-10	-10
27	39	8	2	-19	115	-6	-8	9	12
24	37	21	1	-33	121	8	-13	1	-7
7	44	-17	-2	27	126	-13	3	-3	-11
26	43	-1	-9	11	18	79	-8	-1	10
25	48	-6	10	-20	31	84	-5	4	1
29	41	9	-7	-13	11	87	2	8	-9
8	67	-2	0	8	-20	115	7	-5	6
4	68	-2	0	1	-10	124	1	0	-11
10	48	-2	1	-14	42	2	64	0	-5
28	66	14	-6	-5	4	-5	88	1	7
23	95	-3	3	7	-13	5	112	-2	-5
13	86	6	1	-3	0	0	-1	97	-2
21	66	5	8	-11	-15	23	4	-1	83
18	84	0	-4	6	4	-14	-4	-2	109

The Confusion Matrix for Grade Five, Set D

$$\begin{bmatrix} 51 & 23 & 29 & 9 & 13 & 3 & 25 & 7 \\ 23 & 59 & 22 & 8 & 15 & 4 & 12 & 9 \\ 29 & 22 & 41 & 10 & 10 & 6 & 21 & 6 \\ 9 & 8 & 10 & 30 & 19 & 24 & 11 & 18 \\ 13 & 15 & 10 & 19 & 52 & 11 & 20 & 33 \\ 3 & 4 & 6 & 24 & 11 & 80 & 5 & 14 \\ 25 & 12 & 21 & 11 & 20 & 5 & 89 & 7 \\ 7 & 9 & 6 & 18 & 33 & 14 & 7 & 78 \end{bmatrix}$$

(Entries for $1 - \Delta_j^2$, Φ' and Ω were multiplied by 100.)

The Joint Proportion Matrix for Grade Eight, Set D

Stimulus	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	100														
2	44	100													
3	56	33	100												
4	15	13	13	100											
5	92	41	54	13	100										
6	31	46	67	3	31	100									
7	0	3	5	8	3	8	100								
8	8	8	8	82	8	5	8	100							
9	39	77	36	5	41	46	5	5	100						
10	3	0	3	5	3	3	41	8	0	100					
11	62	49	31	5	59	44	5	3	49	0	100				
12	46	36	36	8	46	36	3	3	39	0	56	100			
13	51	46	33	13	54	33	5	10	46	0	51	33	100		
14	3	0	5	10	5	0	74	10	3	56	0	0	3	100	
15	3	0	3	3	3	3	36	8	0	77	0	0	0	44	100
16	36	46	64	8	33	77	0	5	49	0	41	31	31	0	0
17	31	46	64	3	33	77	5	3	44	0	39	39	46	3	0
18	5	0	3	13	5	3	18	18	0	28	5	0	5	33	21
19	8	8	8	21	10	5	23	26	8	18	13	3	8	28	13
20	5	5	10	15	8	5	51	15	8	33	3	5	5	59	28
21	8	8	5	77	8	5	13	74	3	13	8	3	10	18	10
22	36	51	44	3	39	49	5	3	59	0	44	64	41	3	0
23	3	0	3	5	3	3	39	13	0	90	0	0	0	51	82
24	5	8	8	15	8	5	33	15	10	26	5	3	5	44	31
25	5	5	5	59	5	3	13	62	3	15	3	5	10	21	13
26	8	8	13	67	10	5	10	69	5	8	5	5	13	15	5
27	8	8	5	15	10	0	39	18	3	31	3	3	0	44	28
28	5	8	8	8	8	5	44	10	8	67	5	3	8	56	56
29	8	8	8	64	8	8	8	67	3	10	13	3	13	13	8
30	5	10	3	10	5	3	44	8	5	26	3	0	5	44	23

Stimulus	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
16	100														
17	72	100													
18	0	0	100												
19	5	5	49	100											
20	3	8	21	36	100										
21	10	5	23	21	21	100									
22	46	44	0	5	5	3	100								
23	0	0	23	15	31	10	0	100							
24	3	5	21	36	46	18	5	23	100						
25	3	8	13	21	26	64	3	18	26	100					
26	5	8	13	23	33	72	5	10	23	72	100				
27	3	0	31	36	56	18	0	33	49	18	26	100			
28	5	8	21	23	54	15	5	74	36	21	18	39	100		
29	10	5	21	28	21	72	5	10	18	69	72	15	13	100	
30	5	8	13	26	51	10	3	26	44	23	15	54	33	10	100

(The entries in this matrix were multiplied by 100.)

The Transpose of Latent Partition Matrix for Grade Eight, Set D

Stimulus	$1 - \Delta_j^2$	Latent Categories						
3	69	95	-40	2	-2	40	8	-4
16	71	100	9	2	0	-8	-6	3
17	72	100	9	-1	-3	-8	7	-4
6	83	112	8	-2	3	-15	-6	6
13	41	2	52	8	0	35	-3	1
12	39	6	53	-1	2	30	-4	-4
11	55	-2	61	-2	1	43	-10	12
22	52	18	82	-3	2	1	-2	-3
2	64	-2	114	4	-1	-6	2	-2
9	73	-4	128	-3	0	-14	2	-1
25	62	-1	1	91	5	-4	18	-14
29	68	3	2	97	1	-3	-8	12
26	74	2	-3	100	-8	1	23	-13
4	72	-4	-1	102	-3	9	-6	-3
21	75	1	-1	103	4	-3	-7	7
8	74	-2	1	103	4	-2	-15	8
28	61	1	7	2	60	0	48	-8
15	66	0	-1	-2	88	1	-1	1
10	86	0	-1	-2	99	0	-4	9
23	98	-1	0	3	112	1	-11	-2
5	90	-3	-3	-1	-1	111	4	-1
1	96	-2	-10	0	1	117	-2	-1
24	39	-2	8	5	-8	-1	83	10
14	63	0	-5	-6	25	0	89	6
7	47	3	3	-9	13	-4	90	-6
27	50	-5	-4	0	-9	7	94	17
30	46	-2	5	-3	-13	-1	108	-11
20	65	3	-2	5	-10	1	120	-8
19	47	-1	7	7	-15	-1	31	75
18	61	1	-4	-2	7	-1	-13	106

The Confusion Matrix for Grade Eight, Set D

$$\begin{bmatrix} 70 & 41 & 6 & 2 & 36 & 4 & 3 \\ 41 & 55 & 6 & 1 & 40 & 5 & 4 \\ 6 & 6 & 70 & 10 & 9 & 17 & 19 \\ 2 & 1 & 10 & 86 & 2 & 37 & 22 \\ 36 & 40 & 9 & 2 & 77 & 5 & 7 \\ 4 & 5 & 17 & 37 & 5 & 52 & 26 \\ 3 & 4 & 19 & 22 & 7 & 26 & 58 \end{bmatrix}$$

(Entries for $1 - \Delta_j^2$, Φ' and Ω were multiplied by 100.)

The Joint Proportion Matrix for Grade Eleven, Set D

Stimulus	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	100														
2	64	100													
3	67	49	100												
4	3	3	5	100											
5	85	69	67	5	100										
6	56	59	74	3	59	100									
7	0	5	0	13	3	0	100								
8	3	0	5	95	5	3	15	100							
9	67	85	51	5	74	62	0	5	100						
10	0	3	0	5	3	0	44	5	0	100					
11	59	49	44	3	54	44	0	3	46	0	100				
12	44	36	46	10	49	54	5	8	44	3	54	100			
13	46	44	26	15	41	44	3	15	41	3	49	44	100		
14	0	0	3	18	0	0	67	18	0	49	0	3	3	100	
15	3	5	3	10	5	3	56	10	3	80	3	3	5	44	100
16	51	69	69	5	56	85	0	5	77	0	41	46	39	0	3
17	49	56	67	3	54	85	0	3	59	0	41	54	54	0	3
18	5	3	5	23	3	3	18	23	3	13	3	10	3	36	15
19	0	5	3	21	3	3	33	23	5	21	0	5	5	41	28
20	8	8	8	23	10	3	41	21	8	21	5	13	5	49	26
21	8	3	10	85	10	5	10	85	5	8	5	10	15	23	8
22	49	54	51	8	54	64	0	5	62	0	49	62	39	0	3
23	3	3	3	5	3	3	44	5	3	87	3	5	3	49	72
24	10	13	10	33	13	10	39	33	13	15	10	10	15	28	31
25	3	3	5	77	8	3	15	77	3	8	3	5	15	18	13
26	3	3	5	82	3	3	13	80	3	5	8	5	15	21	10
27	0	5	0	18	3	3	39	21	3	26	0	8	3	36	36
28	0	3	0	8	3	0	49	8	3	56	0	5	3	46	41
29	3	3	5	82	8	3	15	82	3	8	10	5	15	21	13
30	8	18	5	18	13	8	33	18	15	21	15	13	18	33	26

Stimulus	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
16	100														
17	82	100													
18	3	3	100												
19	3	3	64	100											
20	3	3	33	39	100										
21	5	5	28	21	21	100									
22	62	64	5	3	8	8	100								
23	3	3	13	18	23	10	3	100							
24	10	10	31	36	46	31	13	13	100						
25	3	3	21	26	23	77	5	5	33	100					
26	3	3	23	21	26	82	5	5	33	85	100				
27	3	3	59	64	46	10	3	23	41	15	13	100			
28	0	0	21	26	44	10	0	59	28	8	8	31	100		
29	3	3	23	26	21	82	5	5	33	82	87	15	8	100	
30	10	8	13	18	46	15	13	21	36	23	18	23	36	23	100

(The entries in this matrix were multiplied by 100.)

The Transpose of Latent Partition Matrix for Grade Eleven, Set D

Stimulus	$1 - \Delta_j^2$	Latent Categories					
25	75	94	10	-3	-1	-2	-1
29	84	100	4	-6	3	-1	1
26	84	101	8	-1	-3	-5	-2
21	82	101	-15	-1	5	4	7
8	85	102	-5	3	-5	4	1
4	86	103	-1	3	-5	0	0
14	52	1	74	2	-13	16	28
28	48	-9	77	-2	-7	-5	37
24	40	17	84	3	1	16	-15
7	53	-7	96	1	-13	-1	25
20	56	-3	126	-8	0	13	-21
30	41	2	127	-3	3	-25	-15
12	40	2	16	50	27	1	-4
3	57	3	-15	62	35	7	5
22	55	1	13	68	23	-3	-5
16	82	-1	-3	113	-5	0	1
6	86	-1	-8	120	-11	2	2
17	86	-1	-1	130	-25	-1	0
13	32	14	21	30	36	-11	-4
11	43	1	16	5	73	-9	-4
9	69	-3	11	30	74	-1	-3
2	63	-6	18	23	75	-3	-3
5	83	1	-2	-14	122	2	4
1	82	-1	-12	-26	130	6	5
27	63	-10	27	2	-4	85	0
19	67	1	1	1	0	97	0
18	62	6	-21	-1	7	102	-3
15	65	1	16	1	2	6	78
23	83	0	-5	4	2	-5	101
10	94	2	-17	-1	5	-1	110

The Confusion Matrix for Grade Eleven, Set D

$$\begin{bmatrix} 82 & 19 & 5 & 6 & 22 & 7 \\ 19 & 39 & 8 & 9 & 30 & 32 \\ 5 & 8 & 69 & 54 & 2 & 0 \\ 6 & 9 & 54 & 68 & 0 & -1 \\ 22 & 30 & 2 & 0 & 70 & 23 \\ 7 & 32 & 0 & -1 & 23 & 86 \end{bmatrix}$$

(Entries for $1 - \Delta_j^2$, Φ' and Ω were multiplied by 100.)

The Joint Proportion Matrix for Grade Five, Set E

Stimulus	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	100														
2	8	100													
3	8	8	100												
4	0	25	22	100											
5	6	0	25	6	100										
6	3	19	31	14	3	100									
7	25	11	14	6	22	0	100								
8	14	11	14	17	67	11	6	100							
9	8	17	28	11	11	17	11	8	100						
10	36	6	8	3	6	6	8	14	56	100					
11	61	33	6	22	0	14	31	11	6	6	100				
12	3	31	14	25	6	36	11	17	8	3	25	100			
13	8	3	42	6	64	22	14	56	25	11	6	8	100		
14	11	11	19	28	19	19	22	6	19	8	8	14	19	100	
15	42	17	31	11	3	17	25	22	11	22	36	14	11	14	100
16	6	25	8	22	3	11	8	8	42	50	25	22	6	3	8
17	50	33	8	0	6	6	11	14	19	44	22	8	11	19	31
18	6	3	11	3	19	8	22	0	36	33	0	8	11	28	3
19	36	6	28	6	11	17	39	3	22	11	42	14	22	31	25
20	6	28	8	19	6	17	8	8	56	50	25	31	6	6	8
21	6	17	17	25	8	25	8	11	31	28	19	22	11	6	8
22	3	6	19	17	39	6	22	25	8	3	3	3	25	28	14
23	6	3	28	14	47	14	19	31	19	14	0	3	33	33	8
24	6	19	22	28	6	36	8	17	17	8	22	36	8	17	14
25	19	28	8	22	8	31	11	22	6	3	44	44	11	11	17
26	6	3	17	3	56	11	22	33	11	6	3	3	53	31	6
27	28	22	11	19	3	19	14	11	8	6	44	25	8	11	25
28	17	25	8	31	0	28	11	14	6	3	39	47	6	11	19
29	42	3	17	3	3	19	8	17	17	50	14	11	8	3	42
30	14	3	19	0	31	11	22	8	14	6	6	19	22	31	8

Stimulus	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
16	100														
17	8	100													
18	44	8	100												
19	14	25	17	100											
20	75	6	36	6	100										
21	47	6	25	8	42	100									
22	6	3	22	17	0	8	100								
23	3	8	22	17	6	11	53	100							
24	19	6	8	8	31	28	19	39	100						
25	19	19	3	28	22	19	6	3	39	100					
26	3	11	39	17	3	6	39	36	6	11	100				
27	17	25	11	33	19	25	3	3	19	36	11	100			
28	19	17	3	31	22	19	3	3	31	56	6	53	100		
29	19	42	17	14	14	8	6	3	6	8	3	11	8	100	
30	3	8	39	19	3	6	31	28	14	14	36	14	8	11	100

(The entries in this matrix were multiplied by 100.)

The Transpose of Latent Partition Matrix for Grade Five, Set E

Stimulus	$1 - \Delta_j^2$	Latent Categories								
26	55	74	5	8	-16	0	36	-11	-4	8
30	38	81	25	-1	-25	16	-4	11	-6	-3
18	66	109	0	-17	33	-1	-13	9	-13	-7
2	30	-22	38	-4	26	17	0	-24	9	37
27	37	16	56	5	0	-23	-1	-5	41	9
6	40	-4	75	62	-7	2	-11	20	-35	-7
25	52	7	96	-15	-2	-11	13	-2	18	7
28	55	9	100	-6	-3	-18	2	-4	19	6
12	46	10	103	-3	4	-4	2	9	-18	-3
19	50	31	-1	68	-13	-16	-21	-11	67	3
9	56	5	-30	72	69	1	-12	-8	-10	16
13	77	5	-7	101	-2	-37	58	-11	-6	2
3	49	-20	1	123	-6	20	-11	10	-6	-12
21	31	-3	23	13	54	12	1	-1	2	-10
10	74	7	-40	1	68	4	3	39	-7	26
16	72	16	4	-14	98	-8	4	-1	14	-12
20	78	3	11	-6	104	-2	4	-6	5	-8
14	35	37	8	32	-14	50	-21	-15	1	22
4	26	-30	34	9	20	52	-3	-13	8	-1
24	48	-25	60	-3	14	85	-8	8	-11	-7
22	44	25	-13	-14	-12	95	10	0	10	-6
23	64	2	-22	5	-3	125	9	-3	-2	4
5	79	27	-15	6	-2	14	77	-10	5	-3
8	74	-28	16	-14	6	13	89	14	2	1
29	65	10	10	0	-4	-5	3	83	-7	1
15	40	-20	3	30	-12	20	-2	39	44	-3
7	29	35	-18	12	-5	20	-7	-6	62	-7
1	68	0	-27	-9	-10	0	4	33	92	14
11	82	-18	13	-11	14	0	4	-10	127	-11
17	99	-2	1	-4	-4	-1	0	2	-3	115

The Confusion Matrix for Grade Five, Set E

$$\begin{bmatrix} 51 & 4 & 20 & 15 & 21 & 24 & 7 & 10 & 12 \\ 4 & 48 & 13 & 18 & 12 & 7 & 5 & 23 & 11 \\ 20 & 13 & 37 & 12 & 20 & 26 & 15 & 13 & 13 \\ 15 & 18 & 12 & 71 & 9 & 2 & 24 & 12 & 15 \\ 21 & 12 & 20 & 9 & 37 & 25 & 4 & 8 & 7 \\ 24 & 7 & 26 & 2 & 25 & 96 & 5 & 7 & 10 \\ 7 & 5 & 15 & 24 & 4 & 5 & 93 & 24 & 42 \\ 10 & 23 & 13 & 12 & 8 & 7 & 24 & 53 & 27 \\ 12 & 11 & 13 & 15 & 7 & 10 & 42 & 27 & 76 \end{bmatrix}$$

(Entries for $1 - \Delta_j^2$, Φ' and Ω were multiplied by 100.)

The Joint Proportion Matrix for Grade Eight, Set E

Stimulus	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	100														
2	18	100													
3	21	13	100												
4	13	47	21	100											
5	13	5	18	11	100										
6	16	42	29	37	3	100									
7	21	8	18	13	29	3	100								
8	29	3	13	16	55	5	16	100							
9	18	8	45	16	18	21	11	16	100						
10	47	13	21	5	11	16	11	29	37	100					
11	42	45	32	45	8	50	5	11	21	13	100				
12	16	34	29	47	8	61	5	8	16	11	50	100			
13	16	5	53	13	26	11	21	29	40	11	16	13	100		
14	11	5	24	13	42	5	40	29	32	13	5	16	26	100	
15	68	32	24	24	11	26	13	24	16	53	45	26	8	11	100
16	18	42	24	34	5	50	5	8	37	37	50	40	8	5	29
17	61	34	21	13	11	24	8	21	24	53	29	21	11	11	66
18	0	5	18	11	40	3	37	21	37	18	0	3	21	53	0
19	18	16	47	16	11	18	26	11	37	16	34	21	50	29	24
20	16	26	18	21	8	32	8	3	47	37	18	32	16	11	21
21	16	37	21	53	8	50	8	8	18	16	40	53	5	8	26
22	3	0	29	13	45	0	34	40	24	8	3	11	21	55	5
23	11	5	24	13	47	3	47	32	16	13	8	5	24	45	11
24	8	24	34	37	21	50	13	26	24	3	37	42	11	24	13
25	21	42	26	42	3	66	5	13	21	13	61	58	13	11	34
26	5	5	16	5	50	5	42	34	26	8	3	3	29	55	0
27	29	53	21	53	0	61	8	5	24	16	55	55	5	3	32
28	16	40	29	42	0	74	5	8	21	13	50	71	11	11	26
29	50	13	18	3	21	18	13	34	29	71	13	11	8	21	47
30	8	8	21	11	45	3	42	26	26	8	3	3	29	61	3

Stimulus	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
16	100														
17	26	100													
18	13	3	100												
19	18	24	18	100											
20	61	29	18	18	100										
21	53	18	5	13	42	100									
22	3	8	55	26	5	8	100								
23	8	8	42	21	5	11	68	100							
24	37	8	24	18	18	34	37	21	100						
25	47	32	3	29	26	40	5	5	47	100					
26	3	5	63	21	8	5	61	50	24	3	100				
27	42	24	3	18	29	55	0	0	32	47	5	100			
28	45	21	3	18	26	47	5	5	47	63	3	63	100		
29	16	47	18	13	18	11	13	11	11	11	13	13	11	100	
30	3	5	76	18	8	0	53	42	21	3	74	3	3	13	100

(The entries in this matrix were multiplied by 100.)

The Transpose of Latent Partition Matrix for Grade Eight, Set E

Stimulus	$1 - \Delta_j^2$	Latent Categories					
2	42	73	36	-4	-37	35	-18
24	47	83	-31	1	50	-3	4
11	59	85	41	-25	-15	-2	24
21	47	86	-6	27	-3	8	-18
4	41	89	7	-13	-7	21	-6
25	58	98	9	-7	7	-15	14
27	60	98	22	0	-26	16	-11
12	58	105	-8	-1	15	-14	5
6	64	106	-11	15	12	-18	-2
28	66	112	-10	2	14	-17	2
29	57	-28	54	49	46	-12	-14
17	57	-3	85	19	-1	0	2
15	71	13	104	-5	1	-2	-1
1	66	-7	106	-11	5	0	8
16	59	61	-11	72	-13	4	-9
9	57	-12	-21	79	-3	10	54
10	75	-38	49	86	29	-14	-12
20	54	18	-18	97	-24	15	-1
5	47	3	-2	-7	68	33	-3
8	52	4	10	-5	103	-18	-3
23	46	6	4	-17	36	61	7
22	62	8	-15	-11	53	61	9
14	50	1	1	-1	17	76	13
7	32	0	27	-20	-11	76	10
26	67	-1	-4	-4	13	103	-3
18	69	-10	-15	34	-10	113	-9
30	72	-6	5	-2	-14	124	-2
3	54	15	-3	8	12	-16	90
19	52	4	20	-8	-25	13	93
13	52	-13	-5	-1	8	-4	99

The Confusion Matrix for Grade Eight, Set E

$$\begin{bmatrix} 54 & 21 & 25 & 7 & 7 & 18 \\ 21 & 63 & 31 & 18 & 4 & 16 \\ 25 & 31 & 57 & 14 & 11 & 20 \\ 7 & 18 & 14 & 58 & 37 & 23 \\ 7 & 4 & 11 & 37 & 56 & 25 \\ 18 & 16 & 20 & 23 & 25 & 57 \end{bmatrix}$$

(Entries for $1 - \Delta_j^2$, Φ' and Ω were multiplied by 100.)

The Joint Proportion Matrix for Grade Eleven, Set E

Stimulus	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	100														
2	8	100													
3	13	3	100												
4	5	45	13	100											
5	8	3	18	18	100										
6	5	48	20	38	10	100									
7	10	3	30	10	40	5	100								
8	43	8	8	15	43	15	3	100							
9	8	8	48	3	23	5	40	10	100						
10	65	5	13	5	15	3	8	45	18	100					
11	33	50	3	40	5	43	10	13	3	13	100				
12	10	45	8	40	8	58	3	13	0	5	40	100			
13	5	0	55	5	38	10	30	33	48	3	5	0	100		
14	8	0	35	15	43	5	43	13	35	8	5	5	35	100	
15	65	15	18	20	8	20	8	48	5	55	23	20	3	5	100
16	8	65	5	48	3	53	8	13	20	15	53	48	5	3	13
17	68	23	18	5	5	8	5	43	18	60	5	5	8	5	63
18	3	3	25	13	48	3	50	8	45	15	3	0	30	58	0
19	18	3	55	5	18	8	35	10	53	5	23	3	60	33	0
20	8	38	8	35	8	45	13	13	30	15	35	50	8	5	13
21	8	60	0	53	8	48	10	13	10	10	53	50	8	3	15
22	0	0	23	15	70	10	50	30	28	5	0	0	40	53	0
23	0	0	33	13	55	10	48	25	38	3	0	3	48	65	0
24	5	40	15	38	8	83	5	18	5	3	38	55	10	0	20
25	13	40	8	33	10	68	5	20	10	5	50	60	13	5	18
26	3	0	28	13	55	5	48	20	30	5	3	5	45	63	0
27	25	48	5	45	5	40	5	23	3	20	55	48	5	5	20
28	8	43	8	33	5	73	3	15	5	5	43	70	8	5	15
29	70	5	13	3	10	5	10	43	10	83	15	8	3	8	68
30	5	0	25	13	48	3	50	10	30	10	0	0	30	60	3

Stimulus	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
16	100														
17	5	100													
18	15	3	100												
19	8	10	28	100											
20	70	5	20	13	100										
21	78	5	10	5	55	100									
22	0	0	58	23	5	3	100								
23	0	0	48	30	5	0	65	100							
24	48	5	0	8	45	45	8	8	100						
25	48	10	3	20	48	50	3	3	68	100					
26	3	3	68	33	8	8	65	50	3	8	100				
27	55	18	0	15	38	60	0	3	38	43	5	100			
28	53	5	0	10	48	48	0	3	70	73	8	50	100		
29	10	63	10	5	10	8	3	3	5	8	5	23	8	100	
30	0	3	75	25	5	0	58	50	3	0	73	8	3	13	100

(The entries in this matrix were multiplied by 100.)

The Transpose of Latent Partition Matrix for Grade Eleven, Set E

Stimulus	$1 - \Delta_j^2$	Latent Categories					
7	41	66	23	7	4	-4	-3
14	54	73	15	-8	0	5	15
26	66	79	3	-5	-7	5	31
30	72	112	-15	-11	8	8	-3
18	76	117	-5	15	8	-10	-19
9	52	32	85	19	10	-14	-30
3	51	7	94	-22	12	21	-16
13	70	-29	104	-2	-19	-4	54
19	64	-4	115	6	0	-2	-15
20	47	20	10	67	5	22	-23
4	38	4	-11	71	-8	5	27
11	44	-9	8	72	10	11	4
27	49	-9	0	79	14	7	13
2	50	-5	-4	88	-1	4	3
21	76	-4	-4	122	-8	-12	10
16	81	8	5	123	-2	-8	-14
15	61	-9	-6	-8	85	20	18
17	59	-10	14	-5	87	-2	7
1	69	-7	9	1	95	-4	6
10	69	14	-6	9	97	-14	1
29	81	18	-11	-7	108	1	-5
12	56	5	-13	24	2	74	-2
25	65	-7	11	8	1	91	1
28	75	6	-4	-1	1	108	-10
6	77	0	1	-8	-3	113	3
24	73	-4	1	-14	-3	114	4
23	58	37	25	-10	-18	4	60
22	73	47	-7	-5	-20	0	85
5	64	23	-11	2	-13	-3	101
8	63	-50	4	5	35	0	111

The Confusion Matrix for Grade Eleven, Set E

$$\begin{bmatrix} 67 & 32 & 4 & 0 & 3 & 37 \\ 32 & 55 & 7 & 8 & 9 & 23 \\ 4 & 7 & 60 & 13 & 45 & 6 \\ 0 & 8 & 13 & 73 & 10 & 16 \\ 3 & 9 & 45 & 10 & 66 & 10 \\ 37 & 23 & 6 & 16 & 10 & 51 \end{bmatrix}$$

(Entries for $1 - \Delta_j^2$, Φ' and Ω were multiplied by 100.)

APPENDIX D

Theoretical and Latent Partition Matrices, with Cross Tabulation Matrices, for the Five Sets of Word Definitions

The Four Different Partitions of Set A

The Theoretical Partition

$$\begin{bmatrix}
0&1&0&0&0&0&0&0&1&0&0&0&1&0&0&0&0&0&0&1&0&0&0&0&1&0&0&0&1&0\\
1&0&1&0&0&0&0&0&0&0&0&1&0&1&0&0&0&0&0&0&1&0&0&0&0&0&0&1&0&0\\
0&0&0&0&0&0&0&1&0&0&0&0&0&0&0&1&0&1&0&0&0&1&0&0&0&1&0&0&0&1\\
0&0&0&0&1&1&0&0&0&0&1&0&0&0&1&0&0&0&1&0&0&0&1&0&0&0&0&0&0&0\\
0&0&0&1&0&0&1&0&0&1&0&0&0&0&0&0&1&0&0&0&0&0&0&1&0&0&1&0&0&0
\end{bmatrix}$$

Latent Partition for Grade Eleven

$$\begin{bmatrix}
0&1&0&0&0&0&0&0&1&0&0&0&1&0&0&0&0&0&0&1&0&0&0&0&1&0&0&0&1&0\\
1&0&1&0&0&0&0&0&0&0&0&1&0&1&0&0&0&0&0&0&1&0&0&0&0&0&0&1&0&0\\
0&0&0&0&0&0&0&1&0&0&0&0&0&0&0&1&0&1&0&0&0&1&0&0&0&1&0&0&0&1\\
0&0&0&0&1&1&0&0&0&0&1&0&0&0&1&0&0&0&1&0&0&0&1&0&0&0&0&0&0&0\\
0&0&0&1&0&0&0&0&0&0&0&0&0&0&0&0&1&0&0&0&0&0&0&0&0&0&1&0&0&0\\
0&0&0&0&0&0&1&0&0&1&0&0&0&0&0&0&0&0&0&0&0&0&0&1&0&0&0&0&0&0
\end{bmatrix}$$

Latent Partition for Grade Eight

$$\begin{bmatrix}
0&1&0&0&0&0&0&0&1&0&0&0&1&0&0&0&0&0&0&1&0&0&0&0&1&0&0&0&1&0\\
1&0&1&0&0&0&0&0&0&0&1&1&0&0&0&0&0&0&1&0&1&1&0&0&0&0&0&1&0&0\\
0&0&0&0&0&0&0&1&0&0&0&0&0&0&0&1&0&1&0&0&0&0&0&0&0&1&0&0&0&1\\
0&0&0&0&0&1&0&0&0&0&0&0&0&1&1&0&0&0&0&0&0&0&1&0&0&0&0&0&0&0\\
0&0&0&1&0&0&0&0&0&0&0&0&0&0&0&0&1&0&0&0&0&0&0&0&0&0&1&0&0&0\\
0&0&0&0&1&0&1&0&0&1&0&0&0&0&0&0&0&0&0&0&0&0&0&1&0&0&0&0&0&0
\end{bmatrix}$$

Latent Partition for Grade Five

$$\begin{bmatrix}
0&1&0&0&0&0&0&0&1&0&0&0&1&0&0&0&0&0&0&1&0&0&0&0&1&0&0&0&1&0\\
0&0&1&0&0&0&0&0&0&0&0&1&0&0&0&0&0&0&1&0&1&0&0&0&0&0&0&1&0&0\\
0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&1&0&0&0&0&0&0&0&1&0&1&0&0&0&1\\
0&0&0&0&0&0&0&1&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0\\
0&0&0&0&0&0&0&0&0&0&1&0&0&0&0&0&0&0&0&0&0&1&1&0&0&0&0&0&0&0\\
0&0&0&0&0&1&0&0&0&0&0&0&0&1&1&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0\\
0&0&0&1&0&0&0&0&0&1&0&0&0&0&0&0&1&1&0&0&0&0&0&0&0&0&1&0&0&0\\
1&0&0&0&1&0&1&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0
\end{bmatrix}$$

Cross Tabulation Matrices for Set A

Theoretical and Grade Eleven

$$\begin{bmatrix} 6 & 0 & 0 & 0 & 0 & 0 \\ 0 & 6 & 0 & 0 & 0 & 0 \\ 0 & 0 & 6 & 0 & 0 & 0 \\ 0 & 0 & 0 & 6 & 0 & 0 \\ 0 & 0 & 0 & 0 & 3 & 3 \end{bmatrix}$$

Theoretical and Grade Eight

$$\begin{bmatrix} 6 & 0 & 0 & 0 & 0 & 0 \\ 0 & 5 & 0 & 1 & 0 & 0 \\ 0 & 1 & 5 & 0 & 0 & 0 \\ 0 & 2 & 0 & 3 & 0 & 1 \\ 0 & 0 & 0 & 0 & 3 & 3 \end{bmatrix}$$

Theoretical and Grade Five

$$\begin{bmatrix} 6 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 4 & 0 & 0 & 0 & 1 & 0 & 1 \\ 0 & 0 & 3 & 1 & 1 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 & 2 & 2 & 0 & 1 \\ 0 & 0 & 1 & 0 & 0 & 0 & 4 & 1 \end{bmatrix}$$

Grade Eleven and Grade Eight

$$\begin{bmatrix} 6 & 0 & 0 & 0 & 0 & 0 \\ 0 & 5 & 0 & 1 & 0 & 0 \\ 0 & 1 & 5 & 0 & 0 & 0 \\ 0 & 2 & 0 & 3 & 0 & 1 \\ 0 & 0 & 0 & 0 & 3 & 0 \\ 0 & 0 & 0 & 0 & 0 & 3 \end{bmatrix}$$

Grade Eleven and Grade Five

$$\begin{bmatrix} 6 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 4 & 0 & 0 & 0 & 1 & 0 & 1 \\ 0 & 0 & 3 & 1 & 1 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 & 2 & 2 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 3 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 1 & 1 \end{bmatrix}$$

Grade Eight and Grade Five

$$\begin{bmatrix} 6 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 5 & 0 & 0 & 2 & 0 & 0 & 1 \\ 0 & 0 & 3 & 1 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 & 3 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 3 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 1 & 2 \end{bmatrix}$$

The Four Different Partition of Set B

The Theoretical Partition

$$
\begin{bmatrix}
0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 1 & 0 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & 0 & 1 & 0 & 1 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\
1 & 0 & 0 & 0 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 1 & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0
\end{bmatrix}
$$

Latent Partition for Grade Eleven

$$
\begin{bmatrix}
0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 1 & 0 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & 0 & 1 & 0 & 1 & 0 \\
1 & 0 & 0 & 0 & 1 & 0 & 1 & 0 & 1 & 0 & 0 & 1 & 0 & 0 & 1 & 0 & 0 & 1 & 0 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 1 & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0
\end{bmatrix}
$$

Latent Partition for Grade Eight

$$
\begin{bmatrix}
0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 1 & 0 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\
0 & 0 & 1 & 1 & 0 & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & 0 & 1 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\
1 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 1 & 0
\end{bmatrix}
$$

Latent Partition for Grade Five

$$
\begin{bmatrix}
0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & 0 & 1 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 1 & 0 & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 1 & 0
\end{bmatrix}
$$

Cross Tabulation Matrices for Set B

Theoretical and Grade Eleven

$$\begin{bmatrix} 6 & 0 & 0 & 0 & 0 & 0 \\ 0 & 6 & 0 & 0 & 0 & 0 \\ 0 & 0 & 6 & 0 & 0 & 0 \\ 0 & 0 & 4 & 2 & 0 & 0 \\ 0 & 0 & 0 & 0 & 4 & 2 \end{bmatrix}$$

Theoretical and Grade Eight

$$\begin{bmatrix} 6 & 0 & 0 & 0 & 0 & 0 \\ 0 & 5 & 0 & 0 & 0 & 1 \\ 0 & 0 & 4 & 2 & 0 & 0 \\ 0 & 0 & 0 & 1 & 5 & 0 \\ 0 & 4 & 0 & 0 & 0 & 2 \end{bmatrix}$$

Theoretical and Grade Five

$$\begin{bmatrix} 3 & 3 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 5 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 6 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 4 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 2 & 2 & 2 \end{bmatrix}$$

Grade Eleven and Grade Eight

$$\begin{bmatrix} 6 & 0 & 0 & 0 & 0 & 0 \\ 0 & 5 & 0 & 0 & 0 & 1 \\ 0 & 0 & 4 & 3 & 3 & 0 \\ 0 & 0 & 0 & 0 & 2 & 0 \\ 0 & 4 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 2 \end{bmatrix}$$

Grade Eleven and Grade Five

$$\begin{bmatrix} 3 & 3 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 5 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 7 & 2 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 2 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 2 & 2 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 2 \end{bmatrix}$$

Grade Eight and Grade Five

$$\begin{bmatrix} 3 & 3 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 5 & 0 & 0 & 2 & 2 & 0 \\ 0 & 0 & 0 & 4 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 3 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 4 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 3 \end{bmatrix}$$

The Four Different Partitions of Set C

The Theoretical Partition

$$\begin{bmatrix}
1&1&0&0&0&0&0&0&0&1&0&0&0&0&0&0&0&1&1&0&0&1&0&0\\
0&0&1&0&0&0&0&0&0&0&0&1&0&0&0&0&1&0&0&0&1&0&1&1\\
0&0&0&0&0&1&1&1&1&0&1&0&0&0&1&0&0&0&0&0&0&0&0&0\\
0&0&0&1&1&0&0&0&0&0&0&0&1&1&0&1&0&0&0&1&0&0&0&0
\end{bmatrix}$$

Latent Partition for Grade Eleven

$$\begin{bmatrix}
1&1&0&0&0&0&0&0&0&1&0&0&0&0&0&0&0&1&1&0&0&1&0&0\\
0&0&1&0&0&0&0&0&0&0&0&1&0&0&0&0&1&0&0&0&1&0&1&1\\
0&0&0&0&0&0&1&0&1&0&1&0&0&0&1&0&0&0&0&0&0&0&0&0\\
0&0&0&1&0&0&0&0&0&0&0&0&1&1&0&0&0&0&0&0&0&0&0&0\\
0&0&0&0&1&1&0&1&0&0&0&0&0&0&0&1&0&0&0&1&0&0&0&0
\end{bmatrix}$$

Latent Partition for Grade Eight

$$\begin{bmatrix}
1&1&0&0&0&0&0&0&0&1&0&0&0&0&0&0&0&1&1&0&0&1&0&0\\
0&0&1&0&0&0&0&0&0&0&0&1&0&0&0&0&1&0&0&0&1&0&1&1\\
0&0&0&0&0&1&1&1&1&0&1&0&0&0&1&0&0&0&0&0&0&0&0&0\\
0&0&0&1&0&0&0&0&0&0&0&0&1&1&0&0&0&0&0&0&0&0&0&0\\
0&0&0&0&1&0&0&0&0&0&0&0&0&0&0&1&0&0&0&1&0&0&0&0
\end{bmatrix}$$

Latent Partition for Grade Five

$$\begin{bmatrix}
1&1&0&0&0&0&0&0&0&1&0&0&0&0&0&0&0&1&1&0&0&1&0&0\\
0&0&1&0&0&0&0&0&0&0&0&1&0&0&0&0&1&0&0&0&1&0&0&0\\
0&0&0&0&0&0&0&0&0&0&0&0&0&1&0&0&0&0&0&0&0&0&1&1\\
0&0&0&0&0&1&1&1&1&0&1&0&0&0&1&0&0&0&0&0&0&0&0&0\\
0&0&0&1&1&0&0&0&0&0&0&0&1&0&0&1&0&0&0&1&0&0&0&0
\end{bmatrix}$$

Cross Tabulation Matrices for Set C

Theoretical and Grade Eleven

$$\begin{bmatrix} 6 & 0 & 0 & 0 & 0 \\ 0 & 6 & 0 & 0 & 0 \\ 0 & 0 & 4 & 0 & 2 \\ 0 & 0 & 0 & 3 & 3 \end{bmatrix}$$

Theoretical and Grade Eight

$$\begin{bmatrix} 6 & 0 & 0 & 0 & 0 \\ 0 & 6 & 0 & 0 & 0 \\ 0 & 0 & 6 & 0 & 0 \\ 0 & 0 & 0 & 3 & 3 \end{bmatrix}$$

Theoretical and Grade Five

$$\begin{bmatrix} 6 & 0 & 0 & 0 & 0 \\ 0 & 4 & 2 & 0 & 0 \\ 0 & 0 & 0 & 6 & 0 \\ 0 & 0 & 1 & 0 & 5 \end{bmatrix}$$

Grade Eleven and Grade Eight

$$\begin{bmatrix} 6 & 0 & 0 & 0 & 0 \\ 0 & 6 & 0 & 0 & 0 \\ 0 & 0 & 4 & 0 & 0 \\ 0 & 0 & 0 & 3 & 0 \\ 0 & 0 & 2 & 0 & 3 \end{bmatrix}$$

Grade Eleven and Grade Five

$$\begin{bmatrix} 6 & 0 & 0 & 0 & 0 \\ 0 & 4 & 2 & 0 & 0 \\ 0 & 0 & 0 & 4 & 0 \\ 0 & 0 & 1 & 0 & 2 \\ 0 & 0 & 0 & 2 & 3 \end{bmatrix}$$

Grade Eight and Grade Five

$$\begin{bmatrix} 6 & 0 & 0 & 0 & 0 \\ 0 & 4 & 2 & 0 & 0 \\ 0 & 0 & 0 & 6 & 0 \\ 0 & 0 & 1 & 0 & 2 \\ 0 & 0 & 0 & 0 & 3 \end{bmatrix}$$

The Four Different Partitions of Set D

The Theoretical Partition

$$
\begin{bmatrix}
0&0&0&1&0&0&0&1&0&0&0&0&0&0&0&0&0&0&0&0&1&0&0&0&1&1&0&0&1&0\\
0&0&0&0&0&0&1&0&0&0&0&0&0&1&0&0&0&0&0&1&0&0&0&1&0&0&0&1&0&1\\
1&1&0&0&1&0&0&0&1&0&1&0&1&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0\\
0&0&1&0&0&1&0&0&0&0&0&1&0&0&0&1&1&0&0&0&0&1&0&0&0&0&0&0&0&0\\
0&0&0&0&0&0&0&0&0&1&0&0&0&0&1&0&0&1&1&0&0&0&1&0&0&0&1&0&0&0
\end{bmatrix}
$$

Latent Partition for Grade Eleven

$$
\begin{bmatrix}
0&0&0&1&0&0&0&1&0&0&0&0&0&0&0&0&0&0&0&0&1&0&0&0&1&1&0&0&1&0\\
0&0&0&0&0&0&1&0&0&0&0&0&0&1&0&0&0&0&0&1&0&0&0&1&0&0&0&1&0&1\\
1&1&0&0&1&0&0&0&1&0&1&0&1&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0\\
0&0&1&0&0&1&0&0&0&0&0&1&0&0&0&1&1&0&0&0&0&1&0&0&0&0&0&0&0&0\\
0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&1&1&0&0&0&0&0&0&0&1&0&0&0\\
0&0&0&0&0&0&0&0&0&1&0&0&0&0&1&0&0&0&0&0&0&0&1&0&0&0&0&0&0&0
\end{bmatrix}
$$

Latent Partition for Grade Eight

$$
\begin{bmatrix}
0&0&0&1&0&0&0&1&0&0&0&0&0&0&0&0&0&0&0&0&1&0&0&0&1&1&0&0&1&0\\
0&0&0&0&0&0&1&0&0&0&0&0&0&1&0&0&0&0&0&1&0&0&0&1&0&0&1&0&0&1\\
1&0&0&0&1&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0\\
0&1&0&0&0&0&0&0&1&0&1&1&1&0&0&0&0&0&0&0&0&1&0&0&0&0&0&0&0&0\\
0&0&1&0&0&1&0&0&0&0&0&0&0&0&0&1&1&0&0&0&0&0&0&0&0&0&0&0&0&0\\
0&0&0&0&0&0&0&0&0&1&0&0&0&0&1&0&0&0&0&0&0&0&1&0&0&0&0&1&0&0\\
0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&1&1&0&0&0&0&0&0&0&0&0&0&0
\end{bmatrix}
$$

Latent Partition for Grade Five

$$
\begin{bmatrix}
0&0&0&1&0&0&0&1&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&1&1&0&0&1&0\\
0&0&0&0&0&0&1&0&0&0&0&0&0&1&1&0&0&0&1&1&0&0&0&1&0&0&1&0&0&1\\
0&0&0&0&0&0&0&0&0&0&0&0&1&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0\\
1&0&1&0&1&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0\\
0&1&0&0&0&0&0&0&0&0&1&1&0&0&0&0&0&0&0&0&0&1&0&0&0&0&0&0&0&0\\
0&0&0&0&0&1&0&0&1&0&0&0&0&0&0&1&1&0&0&0&0&0&0&0&0&0&0&0&0&0\\
0&0&0&0&0&0&0&0&0&1&0&0&0&0&0&0&0&0&0&0&0&0&1&0&0&0&0&1&0&0\\
0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&1&0&0&1&0&0&0&0&0&0&0&0&0
\end{bmatrix}
$$

Cross Tabulation Matrices for Set D

Theoretical and Grade Eleven

$$\begin{bmatrix} 6 & 0 & 0 & 0 & 0 & 0 \\ 0 & 6 & 0 & 0 & 0 & 0 \\ 0 & 0 & 6 & 0 & 0 & 0 \\ 0 & 0 & 0 & 6 & 0 & 0 \\ 0 & 0 & 0 & 0 & 3 & 3 \end{bmatrix}$$

Theoretical and Grade Eight

$$\begin{bmatrix} 6 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 5 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 2 & 4 & 0 & 0 & 0 \\ 0 & 0 & 0 & 2 & 4 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 3 & 2 \end{bmatrix}$$

Theoretical and Grade Five

$$\begin{bmatrix} 5 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 5 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 1 & 2 & 2 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 2 & 3 & 0 & 0 \\ 0 & 3 & 0 & 0 & 0 & 0 & 2 & 1 \end{bmatrix}$$

Grade Eleven and Grade Eight

$$\begin{bmatrix} 6 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 5 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 2 & 4 & 0 & 0 & 0 \\ 0 & 0 & 0 & 2 & 4 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 2 \\ 0 & 0 & 0 & 0 & 0 & 3 & 0 \end{bmatrix}$$

Grade Eleven and Grade Five

$$\begin{bmatrix} 5 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 5 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 1 & 2 & 2 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 2 & 3 & 0 & 0 \\ 0 & 2 & 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 1 & 0 & 0 & 0 & 0 & 2 & 0 \end{bmatrix}$$

Grade Eight and Grade Five

$$\begin{bmatrix} 5 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 6 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 2 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 4 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 3 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 3 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix}$$

The Four Different Partitions of Set E

The Theoretical Partition

$$\begin{bmatrix}
0&1&0&1&0&0&0&0&0&0&1&0&0&0&0&1&0&0&0&0&1&0&0&0&0&0&1&0&0&0\\
0&0&0&0&0&1&0&0&0&0&0&1&0&0&0&0&0&0&0&1&0&0&0&1&1&0&0&1&0&0\\
0&0&0&0&1&0&1&0&0&0&0&0&0&0&0&0&0&1&0&0&0&1&0&0&0&1&0&0&0&1\\
1&0&0&0&0&0&0&1&0&1&0&0&0&0&1&0&1&0&0&0&0&0&0&0&0&0&0&0&1&0\\
0&0&1&0&0&0&0&0&1&0&0&0&1&1&0&0&0&0&1&0&0&0&1&0&0&0&0&0&0&0
\end{bmatrix}$$

Latent Partition for Grade Eleven

$$\begin{bmatrix}
0&1&0&1&0&0&0&0&0&0&1&0&0&0&0&1&0&0&0&1&1&0&0&0&0&0&1&0&0&0\\
0&0&0&0&0&1&0&0&0&0&0&1&0&0&0&0&0&0&0&0&0&0&0&1&1&0&0&1&0&0\\
0&0&0&0&0&0&1&0&0&0&0&0&0&1&0&0&0&1&0&0&0&0&0&0&0&1&0&0&0&1\\
0&0&0&0&1&0&0&1&0&0&0&0&0&0&0&0&0&0&0&0&0&1&1&0&0&0&0&0&0&0\\
1&0&0&0&0&0&0&0&0&1&0&0&0&0&1&0&1&0&0&0&0&0&0&0&0&0&0&0&1&0\\
0&0&1&0&0&0&0&0&1&0&0&0&1&0&0&0&0&0&1&0&0&0&0&0&0&0&0&0&0&0
\end{bmatrix}$$

Latent Partition for Grade Eight

$$\begin{bmatrix}
0&1&0&1&0&1&0&0&0&0&1&1&0&0&0&0&0&0&0&0&1&0&0&1&1&0&1&1&0&0\\
0&0&0&0&0&0&1&0&0&0&0&0&0&1&0&0&0&1&0&0&0&1&1&0&0&1&0&0&0&1\\
1&0&0&0&0&0&0&0&0&0&0&0&0&0&1&0&1&0&0&0&0&0&0&0&0&0&0&0&1&0\\
0&0&1&0&0&0&0&0&0&0&0&0&1&0&0&0&0&0&1&0&0&0&0&0&0&0&0&0&0&0\\
0&0&0&0&1&0&0&1&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0\\
0&0&0&0&0&0&0&0&1&1&0&0&0&0&0&1&0&0&0&1&0&0&0&0&0&0&0&0&0&0
\end{bmatrix}$$

Latent Partition for Grade Five

$$\begin{bmatrix}
0&0&0&0&0&0&0&0&0&1&0&0&0&0&0&1&0&0&0&1&1&0&0&0&0&0&0&0&0&0\\
0&1&0&0&0&1&0&0&0&0&0&1&0&0&0&0&0&0&0&0&0&0&0&0&1&0&1&1&0&0\\
0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&1&0&0&0&0&0&0&0&1&0&0&0&1\\
0&0&0&0&1&0&0&1&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0\\
0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&1&0&0&0&0&0&0&0&0&0&0&0&0&0\\
0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&1&0\\
1&0&0&0&0&0&1&0&0&0&1&0&0&0&1&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0\\
0&0&1&0&0&0&0&0&1&0&0&0&1&0&0&0&0&0&1&0&0&0&0&0&0&0&0&0&0&0\\
0&0&0&1&0&0&0&0&0&0&0&0&0&1&0&0&0&0&0&0&0&1&1&1&0&0&0&0&0&0
\end{bmatrix}$$

Cross Tabulation Matrices for Set E

Theoretical and Grade Eleven

$$\begin{bmatrix} 6 & 0 & 0 & 0 & 0 & 0 \\ 1 & 5 & 0 & 0 & 0 & 0 \\ 0 & 0 & 4 & 2 & 0 & 0 \\ 0 & 0 & 0 & 1 & 5 & 0 \\ 0 & 0 & 1 & 1 & 0 & 4 \end{bmatrix}$$

Theoretical and Grade Eight

$$\begin{bmatrix} 5 & 0 & 0 & 0 & 0 & 1 \\ 5 & 0 & 0 & 0 & 0 & 1 \\ 0 & 5 & 0 & 0 & 1 & 0 \\ 0 & 0 & 4 & 0 & 1 & 1 \\ 0 & 2 & 0 & 3 & 0 & 1 \end{bmatrix}$$

Theoretical and Grade Five

$$\begin{bmatrix} 2 & 2 & 0 & 0 & 0 & 0 & 1 & 0 & 1 \\ 1 & 4 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 3 & 1 & 0 & 0 & 1 & 0 & 1 \\ 1 & 0 & 0 & 1 & 1 & 1 & 2 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 4 & 2 \end{bmatrix}$$

Grade Eleven and Grade Eight

$$\begin{bmatrix} 5 & 0 & 0 & 0 & 0 & 2 \\ 5 & 0 & 0 & 0 & 0 & 0 \\ 0 & 5 & 0 & 0 & 0 & 0 \\ 0 & 2 & 0 & 0 & 2 & 0 \\ 0 & 0 & 4 & 0 & 0 & 1 \\ 0 & 0 & 0 & 3 & 0 & 1 \end{bmatrix}$$

Grade Eleven and Grade Five

$$\begin{bmatrix} 3 & 2 & 0 & 0 & 0 & 0 & 1 & 0 & 1 \\ 0 & 4 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 3 & 0 & 0 & 0 & 1 & 0 & 1 \\ 0 & 0 & 0 & 2 & 0 & 0 & 0 & 0 & 2 \\ 1 & 0 & 0 & 0 & 1 & 1 & 2 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 4 & 0 \end{bmatrix}$$

Grade Eight and Grade Five

$$\begin{bmatrix} 1 & 6 & 0 & 0 & 0 & 0 & 1 & 0 & 2 \\ 0 & 0 & 3 & 0 & 0 & 0 & 1 & 0 & 3 \\ 0 & 0 & 0 & 0 & 1 & 1 & 2 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 3 & 0 \\ 0 & 0 & 0 & 2 & 0 & 0 & 0 & 0 & 0 \\ 3 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \end{bmatrix}$$

APPENDIX E

SUGGESTED CORRECTION FOR CALCULATING INDEX OF AGREEMENT

Evans (1970, p. 389-391) gives a mathematical method of calculating d_{max} for a given cross tabulation between two categorizations, C_1 and C_2, of the same stimuli:-

n = number of stimuli,

c_1 = number of categories in first categorization,

and c_2 = number of categories in second categorization.

$$d_1 = \left[\frac{n}{c_1 c_2}\right](2c_1c_2 - c_1 - c_2),$$

where [] means "integer part of".

$$p = \text{mod}(n,\ c_1c_2),$$

i.e. the remainder when n is divided by c_1c_2.

$$q = \min\ (c_1,\ c_2).$$

$$d_2 = (2q - 1)\left[\frac{p}{q}\right] + \text{mod}(p,\ q).$$

$$d_3 = \text{mod}(p,\ q) - q, \quad \text{if } p \geq q.$$
$$= 0, \quad \text{if } p < q$$

$$d_4 = -1, \quad \text{if mod}(p,\ q) \neq 0$$
$$= 0, \quad \text{if mod}(p,\ q) = 0$$

It is given that: $d_{max} = d_1 + d_2 + d_3 + d_4$.

It can be shown that this mathematical method of calculating d_{max} results in a matrix similiar to the following:

$$c_1\begin{bmatrix} k+1 & \cdot\ \cdot\ \cdot & k \\ k+1 & & k \\ \cdot & & \cdot \\ \cdot & & \cdot \\ \cdot & & \cdot \end{bmatrix}c_2 \qquad \text{assume } c_1 \leq c_2$$

where $k = \left\lfloor \frac{n}{c_1 c_2} \right\rfloor$, and, then, starting with element (1, 1) and proceeding downwards and then to the right a 1 is added to each element until the sum of the elements of the matrix is n.

This proceedure would appear to be correct when $k > 0$, but if $n \leq c_1 c_2 - c_1$, then at least one column of zeros result which has the effect of reducing the number of categorizations of C_2. The value of d_{max} becomes inflated and an index of agreement of 0 becomes impossible.

As an example, consider two categorizations of the same 4 stimuli, C_1 and C_2. The set C_1 has 2 categories, and C_2 has 3 categories. Using Evans' method, $d_{max} = 4$. A cross tabulation depicting this could be:

$$\begin{bmatrix} 1 & 1 & 0 \\ 1 & 1 & 0 \end{bmatrix}$$

The last category of C_2 has no stimuli sorted into it and therefore can not be considered a category, so the calculation of d_{max} is not applicable. The maximum value of d_{max} should only be 3 and a cross tabulation matrix depicting this could be:

$$\begin{bmatrix} 1 & 1 & 1 \\ 1 & 0 & 0 \end{bmatrix}$$

As a second example, consider two categorizations of the same 30 stimuli, C_3 and C_4. The set C_3 has 5 categories, and C_4 has 12 categories. Using Evans' method, $d_{max} = 49$. A cross tabulation matrix depicting this could be:

$$\begin{bmatrix} 1 & 1 & 1 & 1 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 1 & 1 & 1 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 1 & 1 & 1 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 1 & 1 & 1 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 1 & 1 & 1 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

The last 6 categories of C_4 have no stimuli sorted into them and therefore they can not be considered as categories, so the calculation of d_{max} is not applicable. The maximum value of d_{max} should only be 43 and a cross tabulation matrix depicting this could be:

$$\begin{bmatrix} 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 1 & 1 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 1 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 1 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

In this second example it can be shown that Evans' method of calculating d_{max} results in a value of 49 if the number of categories in C_3 is 5 and the number of categories of C_4 ranges from 6 to 30. Although improbable, if C_4 has 30 categories the number of components of disagreement is always 25 and this, using Evans' d_{max}, results in an index of agreement of 0.49 instead of the expected value of 0.

A correction for Evans' method of calculating d_{max} could be obtained by redefining his quantity d_1 as the following:

$$d_1 = \left[\frac{n}{c_1c_2}\right](c_1c_2 - c_1 - c_2) \qquad \text{if } n \geq c_1c_2$$

$$= -\left[\frac{c_1c_2 - n}{q}\right] \qquad \text{if } n < c_1c_2$$